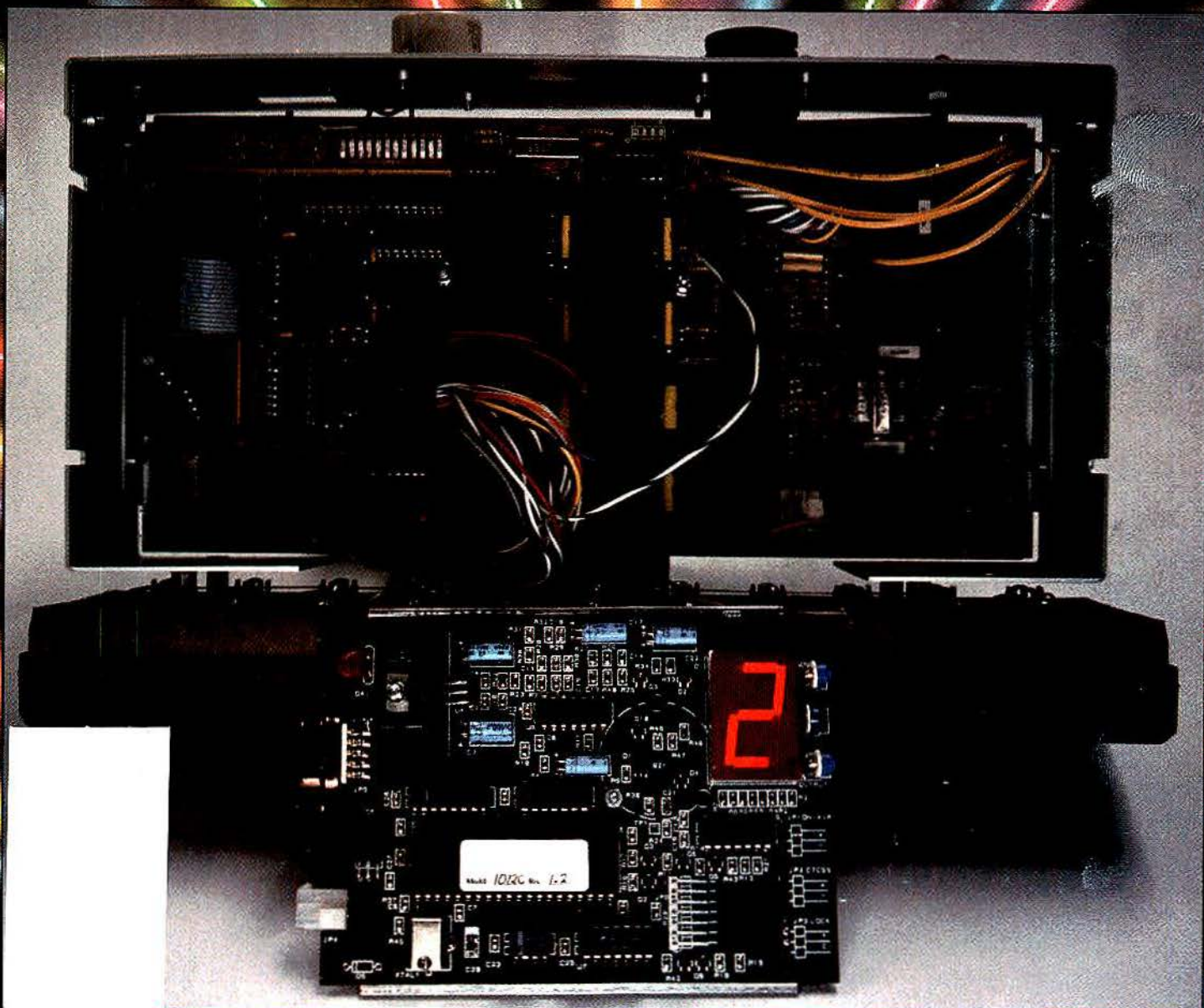


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Mobile Radio Technology™

The journal of mobile communications technology



Embedded microcontrollers, p. 10

VHF amplifier

Radio troubleshooting

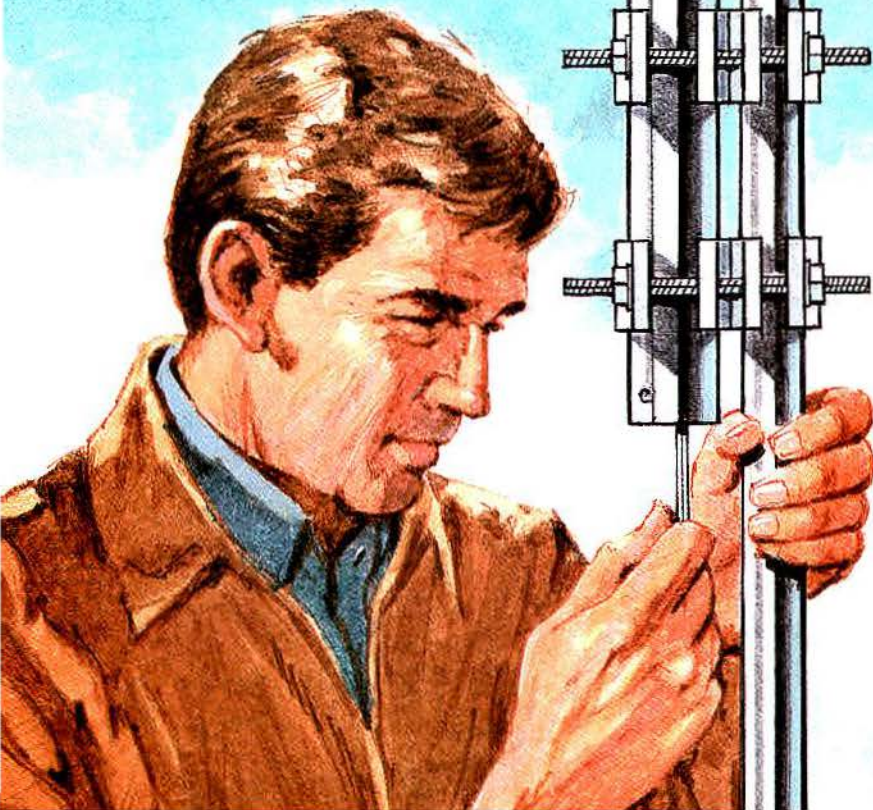
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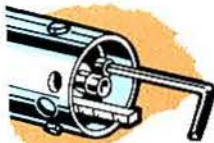
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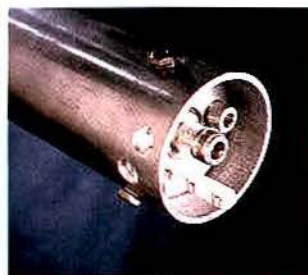
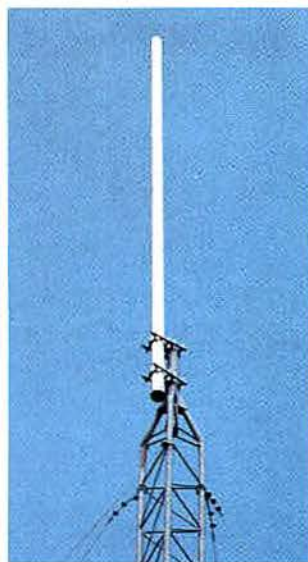
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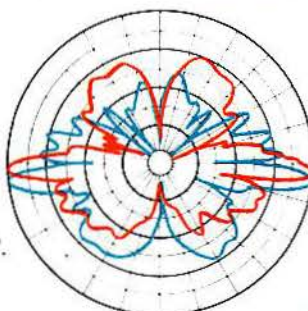
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features

10 Fixing equipment with embedded microcontrollers

William Carlin

Embedded microcontrollers improve radio communications products, but they also call for new maintenance and troubleshooting techniques. Some manufacturers provide for easy testing and troubleshooting.

18 VHF amplifier boosts service monitor output

Dave Ludvigson

Modify a GE Mastr Executive II transceiver's RF amplifier deck for use with low-level service monitor outputs. The transceiver's power amplifier is relatively small, and its layout is adequate for servicing.

24 Radio troubleshooting: Go the extra mile

Mike Mekelburg

Checking supply voltage at the radio box connector during PTT helps to identify a grounding problem with a radio that may work fine on the bench and fail during transmit when installed in a vehicle.

28 New Law, new age: Commercial Mobile Service

Robert H. Schwaninger Jr.

Changes in the Communications Act give common carrier and private carrier system operators much to consider.

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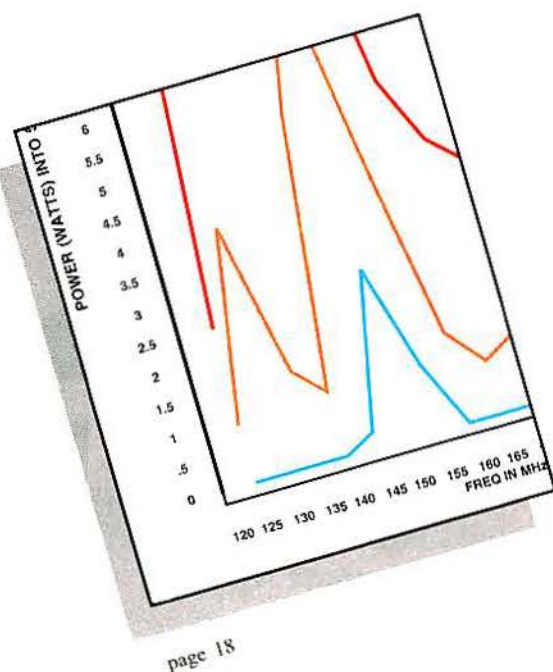
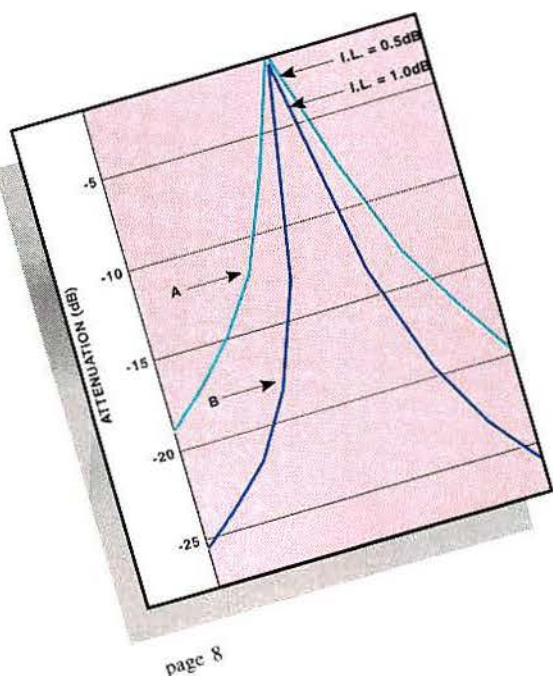
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On the cover: A circuit board from the newest generation of status reporting equipment appears in front of an older board that it replaces. Embedded microcontrollers support miniaturization, but they challenge repair technicians. See William Carlin's article on page 10.

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Circle (5) on Fast Fact Card

The name of diversification: *wireless*



It's getting interesting out there.

"Do you have that radio modem in a wireless model?"

"Can I get a wireless version of a cellular telephone?"

"Instead of a two-way radio, can I have something with wireless communications?"

It's hot. It's *wireless*.

Wireless is the latest buzzword in communications, the word that sizzles, the word that snaps.

Wireless is the mobile communications industry dressed in '90s jargon.

Wireless isn't all language, though. Wireless technology re-shapes communications equipment sales businesses and re-names yet another trade association.

Exit: the Association of Mobile Radio Dealers.

Enter: the Association of Wireless System Integrators, or AWSI.

AWSI is a membership section of the National Association of Business and Educational Radio (NABER), a parent with a stodgy name.

OK, look who's talking. *Mobile Radio Technology*? How about *Agile Wireless Analog-Digital Orbital-Terrestrial Cordless Untethered Data Voice Computer System Personal Industrial User Technology News Enquirer*?

... Back to AWSI.

The name change expresses *diversification*. That's what AWSI volunteer leadership council chairman Tony Sabino told us. Sabino also is presi-

dent of Regional Communications in Paramus, NJ.

First, the word *dealer* is out because it limits customer perception to equipment sales and service. Also, the word reminds us of car dealers and illegal drug dealers. Not that the two have anything in common, except that some people think car dealers have a bad reputation, and most people think illegal drug dealers do, too. Anyway, *dealer* is out.

Second, the word *wireless* is in because it's hot and because it embraces, in the public perception, much more than *radio*.

Third, *system integrator* is in because it indicates that a company offers more than component equipment and repair service.

"Historically, the dealership was where there was more value added in getting the radios together, programming them and servicing them," Sabino said. "That's

changed. Radios don't break much. Servicing is becoming less important, and components are marketed by retailers and catalogs."

Sabino said that dealers—wireless system integrators—who have been in the industry for a while have the expertise, ability and knowledge to take all kinds of wired and wireless communications equipment—and, in many cases, computers—and put them together and deliver them as an overall solution to a customer's requirement. They can keep the software, hardware and network running.

"We happen to believe that the wireless communications industry has great need for a professional and knowledgeable distribution channel," Sabino said. "The future, to use an example, has whole new worlds of

portable computing applications and products that will take advantage of wireless communications. Are customers aware of what wireless products do when there is an interference problem? They never thought of it. On a wired network, the communications link is shielded.

"Who can track down and identify interference and interference-related problems? Probably an AWSI member," Sabino said.

The trend is for dealers to evolve in either of two directions. Some evolve into highly competitive marketing-and-retailing merchants who supply products in volume, moving them out through distribution. Others capitalize on their vast storehouse of experience and knowledge accumulated over the years, making their *wireless system integration* services available to everyone who will benefit from it.

—Don Bishop

What's in a name?

Trade shows and associations change their names to reflect the marketplace. Here are some of the names used by shows and associations since their inception. The word *radio* has disappeared from all of them:

National Business Radio Dealers Conference
National Business Radio Dealers/Users Conference
National Land Mobile Expo
International Mobile Communications Expo
International Mobile Communications Expo/Spring
International Wireless Communications Expo/Spring

Land Mobile Expo/East
Mobilecomm Expo & Cellular Showcase
Mobilexpo & Cellular Showcase
International Mobile Communications Expo/Fall
International Wireless Communications Expo/Fall

Professional Mobile Radio Service Section
Association of Mobile Radio Dealers
Association of Wireless System Integrators

National Mobile Radio System
National Association of Radiotelephone Systems
Telocator Network of America
Telocator - The Mobile Communications Industry Association
Telocator - The Personal Communications Industry Association

Cellular Communications Industry Association
Cellular Radio Communications Association
Cellular Telecommunications Industry Association

Special Industrial Radio Service Association
Industrial Telecommunications Association

American SMR Network Association
American Mobile Telecommunications Association

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 STATE OF IOWA
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- 2-4—**WirelessWorld Conference & Exhibition**, sponsored by *Cellular Business* magazine, Buena Vista Palace, Lake Buena Vista, FL. Contact: Chris Lotesto, 800-458-0479.
- 4-6—**Industrial Telecommunications Association**, La Quinta Hotel, La Quinta, CA. Contact: Barbara J. Levermann, 703-528-5115.
- 11-14—**Communications Marketing Conference**, Holiday Inn Riverwalk, San Antonio. Contact: Gene Johnson, Vega Signaling, 818-442-0782.
- 19—**Radio Club of America**, Communications Symposium, Annual Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

1994

February

- 7-8—**AMTEX**, the American Mobile Telecommunications Association's Marketing and Technology Conference and Exposition, Marriott on International Drive, Orlando, FL. Contact: 202-331-7773.

March

- 2-4—**Cellular Telecommunications Industry Association Winter Meeting and Exposition**, San Diego. Contact: 202-785-0081.
- 6-9—**Energy Telecommunications and Electrical Association**, Henry B. Gonzales Convention Center, San Antonio. Contact: 214-235-0655.

April

- 13-15—**International Wireless Communications Expo/Spring**, Las Vegas Convention Center, Las Vegas. Contact: 303-220-0600.

May

- 2-5—**Supercomm**, sponsored by USTA and TIA, and **International Conference on Communications**, sponsored by IEEE, New Orleans. Contact: USTA, 202-835-3100.

- 12-14—**Mobile Communications Conference**, sponsored by the National Association of Business and Educational Radio (NABER), Peabody Hotel, Orlando, FL. Contact: Nancy Palleschi, 800-759-0300.
- 25-27—**RadioComm**, Vancouver Convention Center, Vancouver, British Columbia. Contact: Bill Eggertson, 613-233-4888.

June

- 7-11—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Stockholm, Sweden. Contact: Professor Sven-Olof Ohrvik, technical chairman, 46 8 757 0483; Fax 46 8 34 8441.
- 18-23—**Utilities Telecommunications Council**, Washington Sheraton, Washington, DC. Contact: Rita Clark, 301-621-7802.

July

- 17-20—**Forestry-Conservation Communications Association**, Hershey, PA. Contact: Don Pfohl, 602-644-3166.

August

- 6-11—**International Municipal Signal Association**, Cavanaugh's Inn, Spokane, WA. Contact: Harold Glerum, 800-723-4672.
- 7-12—**Associated Public-Safety Communications Officers National Conference**, Lawrence Convention Center, Pittsburgh. Contact: 800-824-1850.

September

- 22-24—**Mobile Communications Marketplace**, Washington State Convention Center, Seattle. Contact: 800-326-8638.

October

- 15-20—**International Association of Chiefs of Police**, Albuquerque Convention Center, Albuquerque, NM. Contact: 703-243-6500.
- 19-21—**International Wireless Communications Expo/Fall**, Tampa Convention Center, Tampa, FL. Contact: 303-220-0600.



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The journal of mobile communications technology

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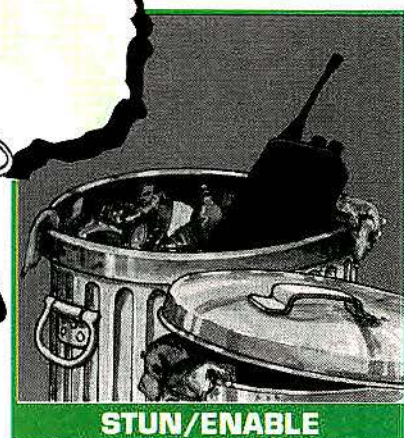
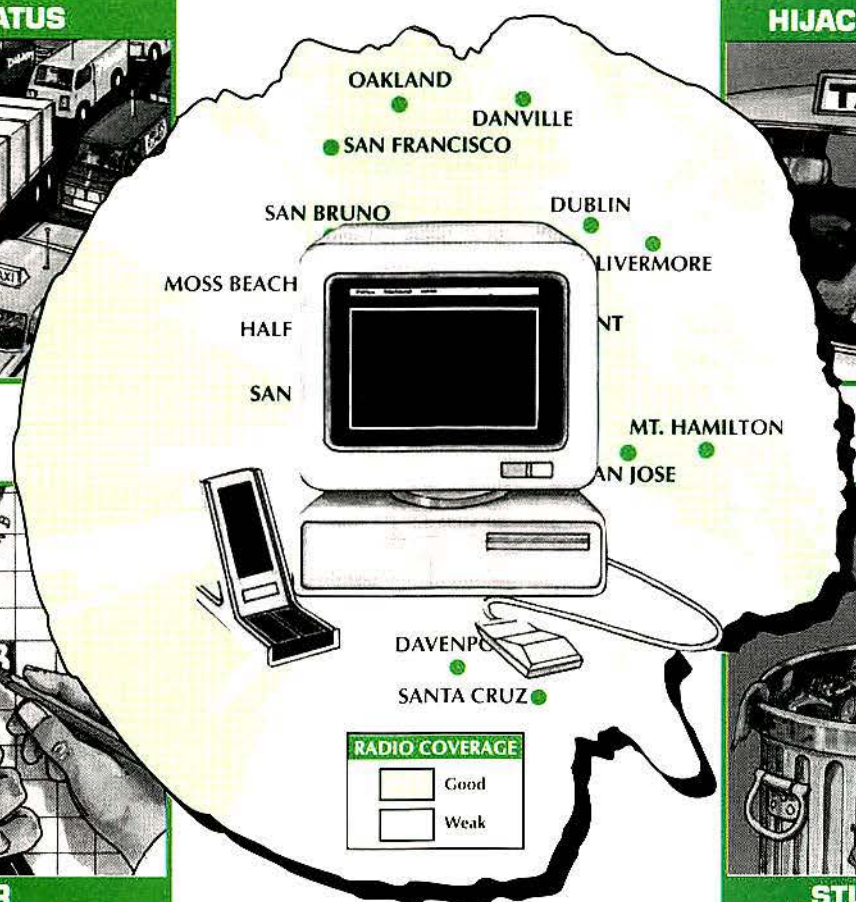
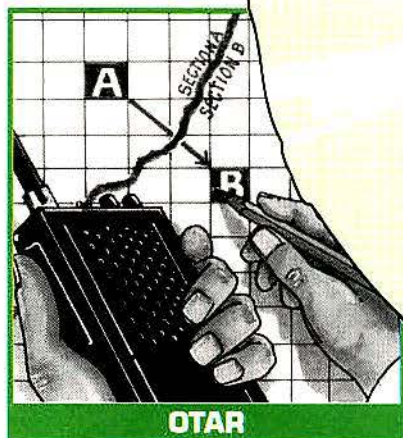
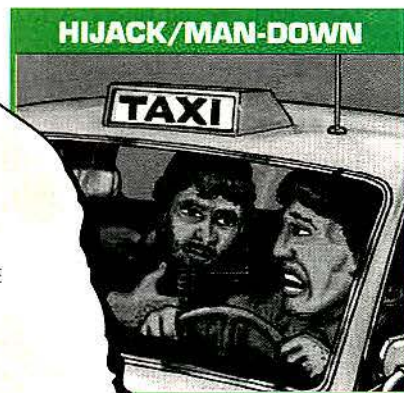
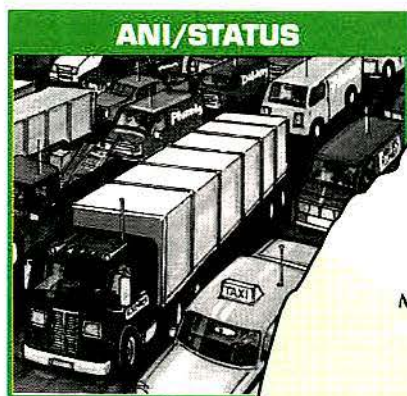
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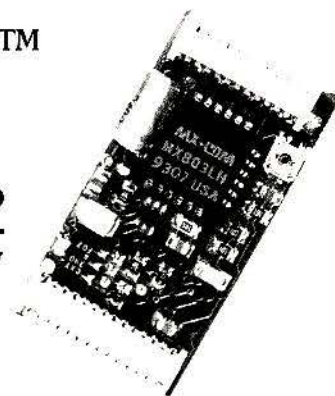
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Circle (7) on Fast Fact Card



Radio frequency filters

By Harold Kinley, CET

Columns in the previous two issues dealt with transmitter noise and receiver desensitization (desense).

These problems commonly are encountered at high-density communication sites. Usually, they can be overcome with special filters. A few typical situations show how cavity filters can be used to solve these interference problems.

Bandpass filter

Figure 1 above shows a typical simplex base station with a single quarterwave cavity bandpass filter inserted in the line to provide filtering for both the receiver and the transmitter.

The selectivity afforded by a single "can" in the bandpass configuration of

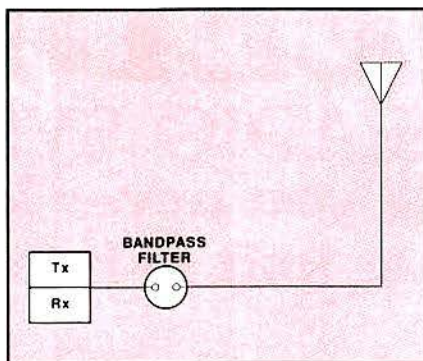


Figure 1. A single-cavity bandpass filter is inserted in the line between the base station and antenna. This increases the selectivity of the receiver and helps to filter out transmitter sideband noise that might interfere with nearby receivers.

Figure 1 is shown by the graphs in Figure 2 below. This information is for the VHF highband range.

Curve A represents the selectivity curve of the bandpass cavity using a 0.5dB coupling loop. Curve B represents the selectivity of the same cavity

using a 1.0dB coupling loop. Other coupling loops with higher insertion loss (looser coupling) could be used for even greater selectivity; nevertheless, after a certain point is reached, the insertion loss starts to degrade the communications system performance seriously.

Two or three cavities can be connected in cascade to achieve better selectivity while maintaining a fairly low insertion loss. The insertion loss is additive, but three cavities in cascade each with 1.0dB coupling loops (for a total of 3.0dB insertion loss) provide much better selectivity than a single

(continued on page 44)

Kinley is a certified electronics technician with the South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, Prentice-Hall, 1985.

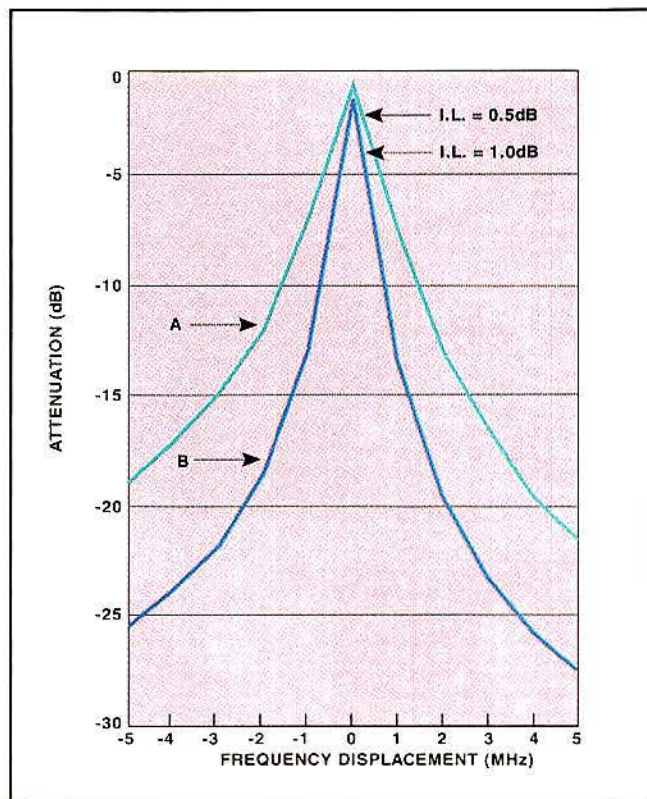


Figure 2. Varying the degree of coupling into and out of the cavity will change the selectivity or 'Q' of the cavity. Tighter coupling (lower insertion loss) lowers the 'Q' and broadens the response. Looser coupling (higher insertion loss) sharpens the response curve and increases the 'Q' of the cavity. Curve A represents the response of the cavity with a 0.5dB coupling loop. Curve B represents the response of the cavity with a 1.0dB coupling loop.

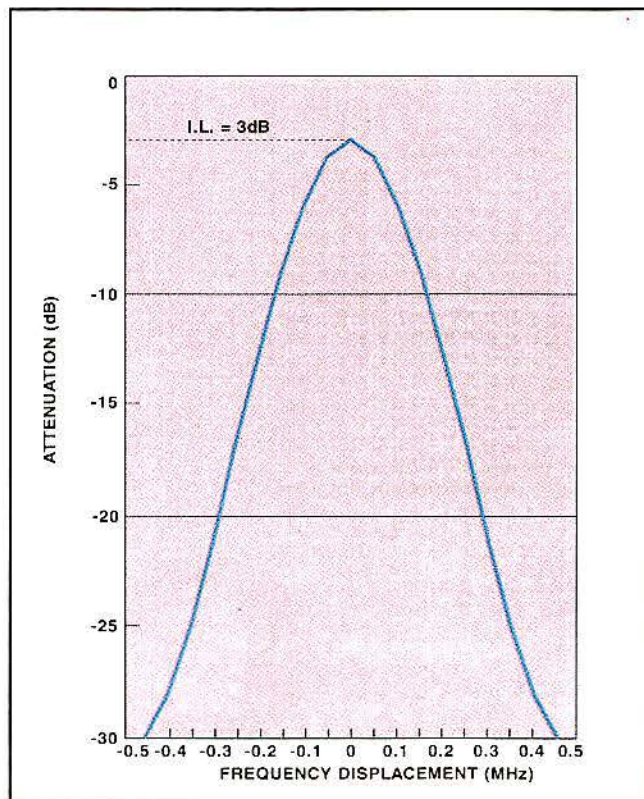


Figure 3. This response curve represents the same cavity as Figure 2 except that a 3.0dB coupling loop is used. Notice how much sharper the response curve has become due to the increased 'Q' of the cavity.

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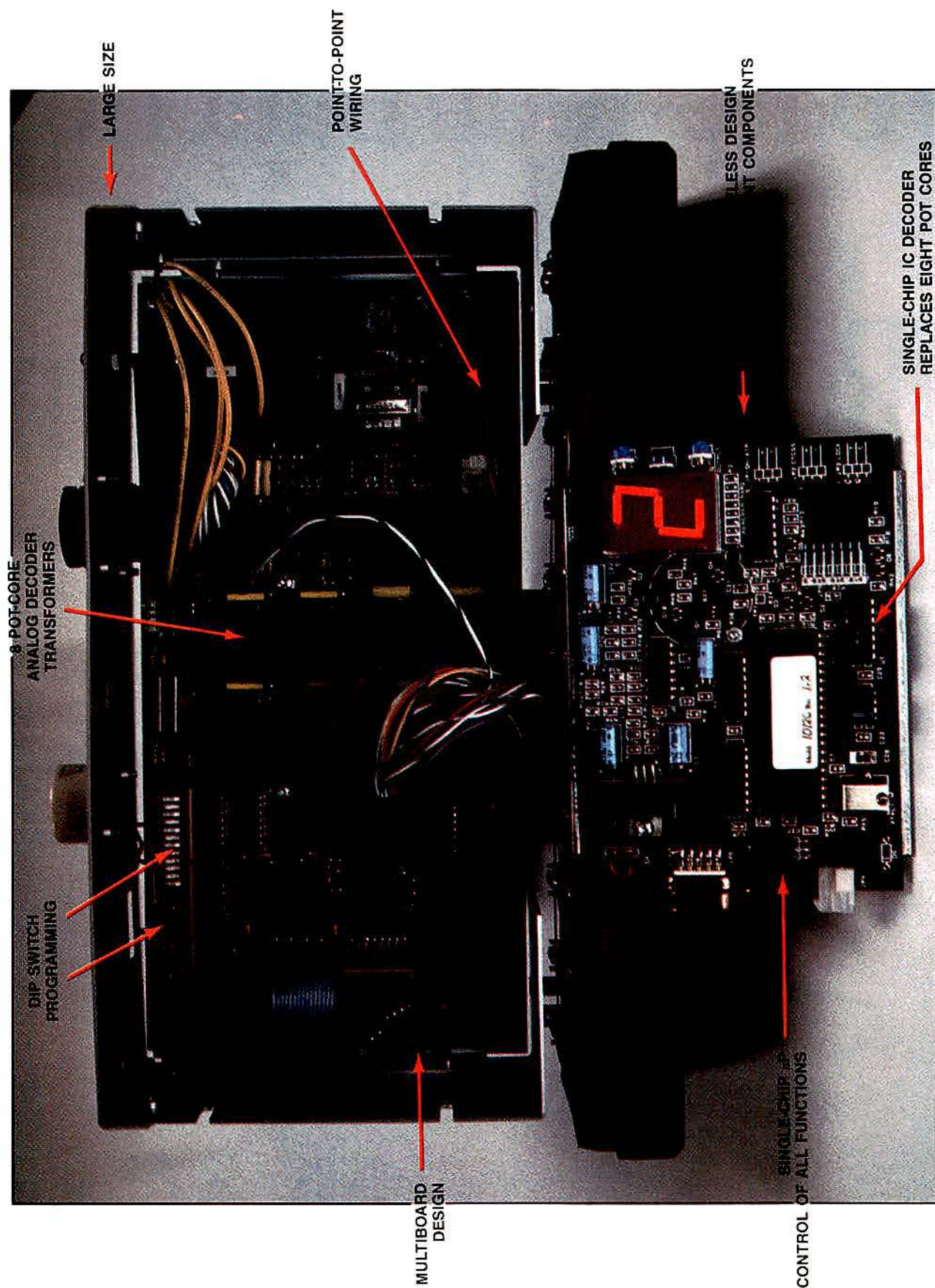
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Fixing equipment with embedded microcontrollers

Embedded microcontrollers improve radio communications products, but they also call for new maintenance and troubleshooting techniques. Some manufacturers provide for easy testing and troubleshooting.

By William Carlin

Component technology advances have produced dramatic results in new products by reducing component count (and therefore product size) and circuit design complexity.

Products that once would have required several printed circuit (PC) boards and stacks of components now can be built with a single embedded controller and a few support integrated circuits (ICs). Additionally, the shift from hardware-based solutions for options and configurations to a software implementation means a further parts reduction, more features and more reliable operation.

Embedded controller

The key component in almost any product with built-in "intelligence" is the embedded controller. What distinguishes this device from a normal microprocessor is that it contains all of the components of a microcomputer system in one IC:

- ▶ the central processing unit (CPU) that does all of the processing.
- ▶ read-only memory (ROM) for program storage, random-access memory (RAM) for holding input data and tem-

porary storage.

▶ input/output (I/O) drivers as interfaces to the rest of the hardware.

▶ clock circuits.

All that is needed to create a functional system is a crystal, additional reset circuitry (if it is needed for a hostile environment such as a mobile environment) and interface circuitry for functions such as keyboard buttons, displays and tone generators.

From a technician's view point, this configuration should greatly simplify the troubleshooting process because it removes the necessity of figuring out complex address schemes between the microprocessor and ROM, RAM and I/O drivers. Everything is handled inside of the one IC.

On the other hand, this consolidation of components produces a *black box* that can be intimidating to troubleshoot without a detailed software description or some way of controlling the processes inside of the embedded controller. This is where good software design can make a difference.

Still, a basic understanding of embedded controllers is helpful when troubleshooting one of these systems. A brief discussion of single-chip microcomputers may be helpful before exploring the possibility of interactive troubleshooting software.

Single-chip microcomputers

The cumbersome interface between CPU, ROM, RAM and I/O is handled inside the IC and need not concern the technician.

If the oscillator is running and the reset line is not held active, assume that the microprocessor is running and,

Most products have some kind of keyboard and display so a technician can respond to prompts and make entries that define operating characteristics. The sequence of photos below shows a device, via its front panel display:



asking for a vehicle number.



asking for a console number.



asking for the PTT delay.



asking for the number of retries.



asking for an ANI option.

At the left: A comparison of an older electronic circuit design and single-board, wireless construction.

Carlin is the owner of Pyramid Communications, Seal Beach, CA. Pyramid manufactures the status reporting equipment mentioned in this article, as well as dispatch and service management software.

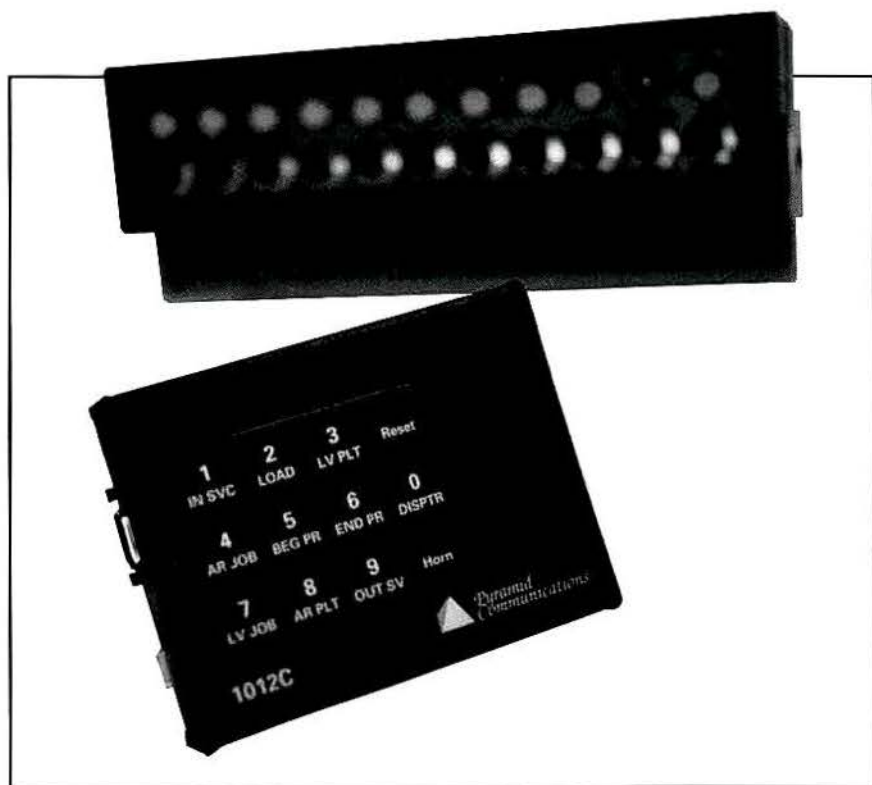


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◆◆◆ **Follow the Leader**



This picture shows an example of the newest generation of status reporting equipment, model 1012C (front) and an older model that it replaces. A picture of these units' circuit boards appears on page 10. The photo sequence on page 11 shows model 1012C.

bedded controllers contain a self-test routine that allows the technician limited access to the *black box*. Manufacturers need to go a step further by providing full manual control of the microprocessor's actions and a detailed flow chart for troubleshooting.

Self-testing

Some aftermarket signaling accessory manufacturers provide a self-test function for alignment and troubleshooting purposes that allows the technician to activate each section of hardware selectively via the keyboard input and display in a "static" condition.

This function enables the technician to take measurements under controlled circumstances and greatly facilitates maintenance and troubleshooting. Even without a storage scope, you can examine the state of the hardware that just received the burst to see whether the correct data transferred. In this way, each piece of hardware under microprocessor control can be checked for proper operation.

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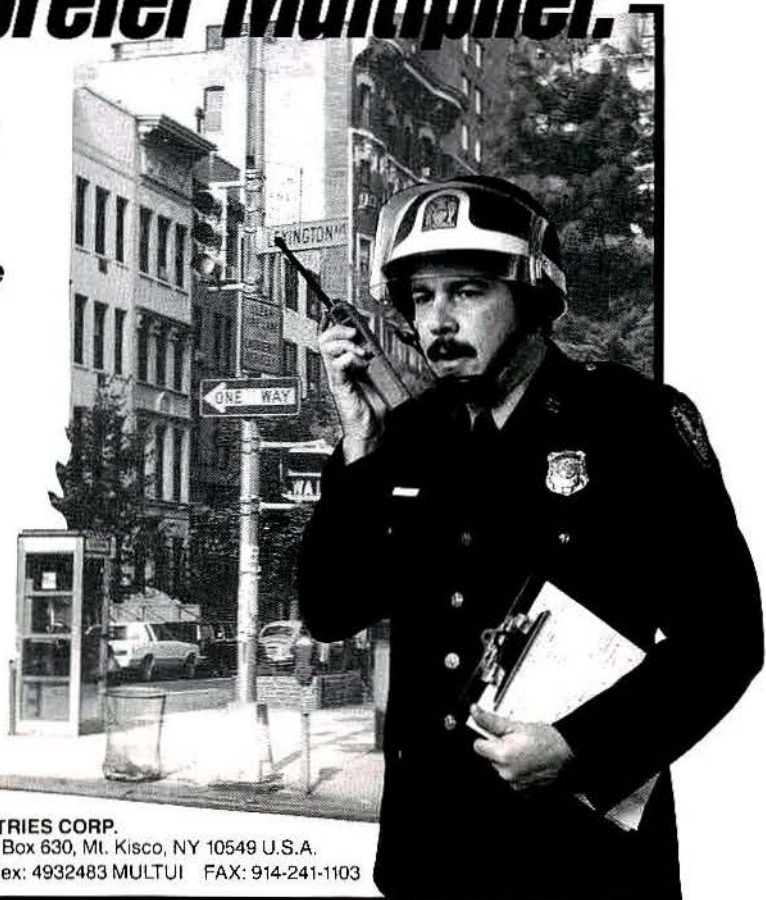
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LARS RAMQVIST, President and Chief Executive Officer, Ericsson.



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► *Options and programming*—The other big advantage of microprocessor-controlled devices is that many of the programmable features or hardware dependent settings can be implemented in software rather than in hardware.

Using dual in-line package (DIP) switches and jumpers for programming can be unreliable. For one thing, they are mechanical devices prone to corrosion and bad connections. For another, they are difficult to use because they require the disassembly of the device and the use of a chart to indicate which jumper or switch settings activate which options. If the technician does not have the chart, programming the device is impossible.

On the other hand, because most products have some kind of keyboard and display, a software solution can be implemented that solves many of these hardware limitations. The technician or user can enter a programming mode without disassembling the device or using a chart or manual. The device, via its programming and display, prompts the user to make entries that define its operating characteristics. (See photographs on page 11.)

Eliminating the DIP switches and jumpers improves reliability, reduces cost and size, and makes the device easier to use. Because programming the device no longer depends on hardware, new features can be added merely by updating the software.

New products will continue to become more sophisticated as newer and more powerful ICs are developed. Products will become more compact, contain more features and present increasingly difficult maintenance and repair challenges.

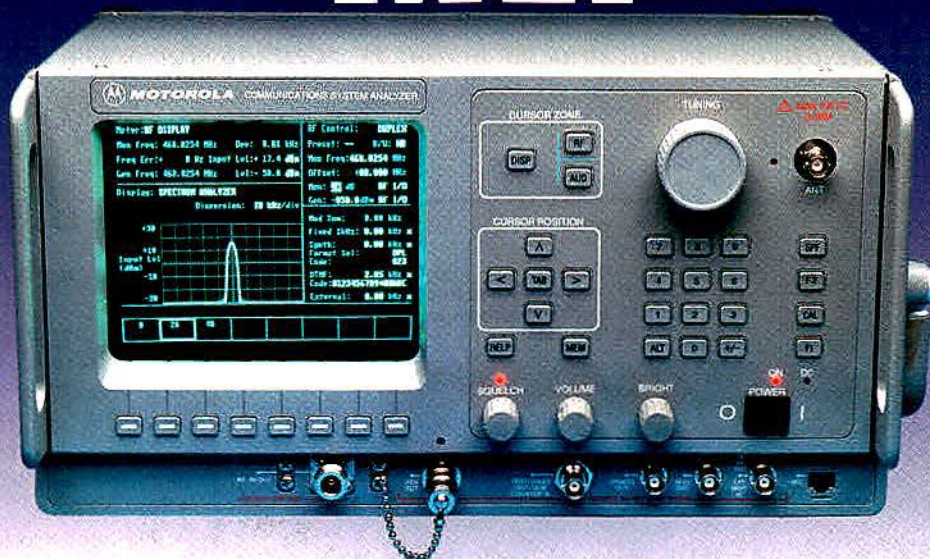
Hardware manufacturers have a tremendous tool at their disposal for improving reliability, maintenance and, ultimately, user satisfaction by the use of intelligent software. A few companies have tapped into this concept of interactive test modes and easy-to-use software configuration, a trend that many hope will continue.



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VHF amplifier boosts service monitor output

Modify a GE Mastr Executive II transceiver's RF amplifier deck for use with low-level service monitor outputs. The transceiver's power amplifier is relatively small, and its layout is adequate for servicing.

By Dave Ludvigson

"Dave, the article was great," said the voice on the phone, referring to Dave Ludvigson's "RF Amplifier Deck Boosts Service Monitor Output" article in the November 1991 issue about modifying a UHF GE Executive II.

"The only problem is, I need to do the same thing with VHF Executive IIs. Can you help?"

The conversation between Ludvigson and Ron Minor inspired this article. Aside from its application in two-way radio service work, this modification may interest amateur radio operators, too.

Readers should note that modifying the Executive II according to the following procedure voids its FCC type acceptance for use under Part 90 of the commission's rules.

Although Ericsson-GE Mobile Communications gave permission for its schematic diagrams to be reproduced in this article, the company's permission does not imply any endorsement or recommendation of the modification.

Service technicians working with RF power amplifier (PA) decks know that such amplifiers are nothing more than multistage class C *switchers*, each capable of handling progressively greater current.

Although class C amplifier efficiency typically ranges from 60% to 75%, each amplifier stage is capable

RF output is taken from the amplifier by means of a cable terminated with an RCA jack.

R5 is removed from the board.

A 1.5K, 0.5W resistor is added between the L3-L4 junction and Q1's base.

R13 is changed to a 750Ω, 0.25W resistor.

The dark blue wire effectively shorts out the Q215 transistor, removing the power control circuitry.

Power ground (common) is provided by the light blue wire beneath the power control potentiometer.

V_{cc}(+) is provided by the orange wire.

Photo 1. Several of the modification steps are shown in this picture of the VHF Executive II intermediate power amplifier board.

Ludvigson is a technician in Houston.

of passing the desired signal and generating spurious sideband energy. With the broadband nature of most commercial PAs, the spurs are amplified, too, resulting in adjacent-frequency splatter.

The drive power requirements and the square wave or impulse nature of toggling a transistor in and out of conduction several hundred million times per second combine to form a designer's nightmare. For an amplifier to amplify a fairly broad range of radio spectrum properly, spurious outputs *must* be reduced to an absolute minimum. Filtering must be applied virtually everywhere in a broadband RF PA deck.

(1) The dc power lines must be bypassed with several capacitors at each end of the power line.

These capacitors must have low reactance X_c values to attenuate all frequencies, from the power supply's ripple frequency to VHF and UHF.

For an amplifier to amplify a fairly broad range of radio spectrum properly, spurious outputs must be reduced to an absolute minimum.

Heavy-gauge, stranded wire can be used for the dc power lines, but the best conductor may be RG-8U cable bonded to several places on the chassis and the amplifier circuit board's ground plane.

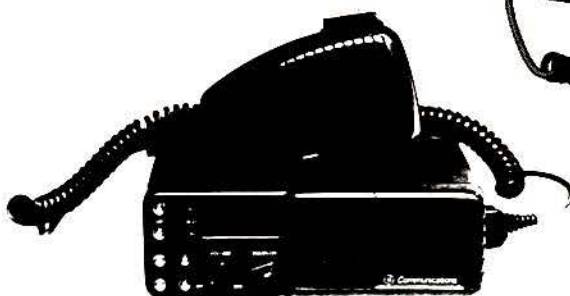
(2) Inter-stage filtering from input and output networks is used to define the range of amplified frequencies.

Inter-stage filtering includes small chip capacitors, toroid coils, transmission lines and etched geometry circuit foil. As a general rule, tapped transmission lines are used in impedance-matching networks. Pi networks are used as low-pass filters, thus reducing high-frequency harmonics.

A further complication arises when the 3dB/octave nature of a transistor is



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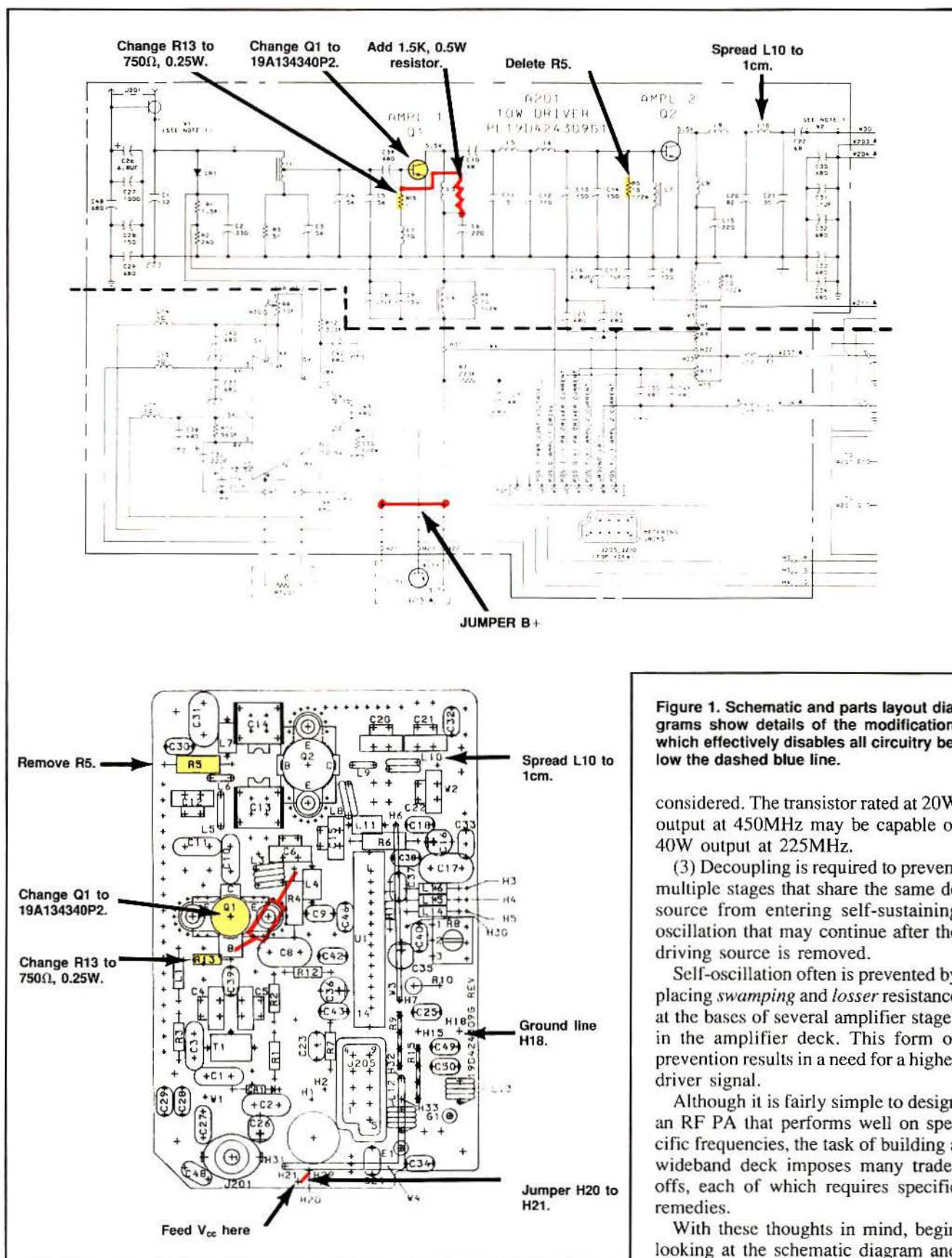


Figure 1. Schematic and parts layout diagrams show details of the modification, which effectively disables all circuitry below the dashed blue line.

considered. The transistor rated at 20W output at 450MHz may be capable of 40W output at 225MHz.

(3) Decoupling is required to prevent multiple stages that share the same dc source from entering self-sustaining oscillation that may continue after the driving source is removed.

Self-oscillation often is prevented by placing *swamping* and *losser* resistance at the bases of several amplifier stages in the amplifier deck. This form of prevention results in a need for a higher driver signal.

Although it is fairly simple to design an RF PA that performs well on specific frequencies, the task of building a wideband deck imposes many trade-offs, each of which requires specific remedies.

With these thoughts in mind, begin looking at the schematic diagram and

Table 1—Power output in watts at various frequencies and various signal voltage inputs.

Freq. (MHz)	0.5V	0.75V	1V	1V*
120	0	0.74	2.4	1.3
121	0	1.3	3.3	2.0
122	0	2	4.5	3.0
123	0	2.5	5.8	4.0
124	0	2.8	7.3	5.1
125	0	4	9.0	6.4
126	0	8	10.7	8.0
127	0.4	5.8	11.6	9.6
128	0.34	4.2	8.1	7.8
129	0.12	2.4	7.7	7.2
130	0	1.5	7.9	7.0
131	0	1.1	8.3	7.2
132	0	0.9	8.5	7.4
133	0	0.9	7.8	7.5
134	0	0.9	7.7	6.5
135	0	1.1	8.1	6.7
136	0	1.4	8.9	6.9
137	0	2	11.1	7.8
138	0	3	11.7	8.9
139	0	4.1	12.2	11.0
140	0	5.3	12.4	12.0
141	0.59	6.3	12.4	12.4
142	1.4	7	12.3	12.8
143	2.1	7.6	12.1	13.0
144	2.6	8.1	11.8	13.1
145	2.7	8	11.5	13.2
146	2.5	7.6	11.2	13.0
147	2.4	7.1	10.8	12.8
148	2	6.5	10.3	12.3
149	1.5	5.7	9.6	11.7
150	1.1	4.5	9.05	10.8
151	0.72	3.6	8.3	10.0
152	0.45	2.9	7.5	9.0
153	0.25	2.3	6.8	8.2
154	0.13	1.8	6.1	7.5
155	0	1.4	5.6	6.7
156	0	1.1	5.2	5.8
157	0	0.9	4.9	5.2
158	0	0.8	4.6	4.9
159	0	0.8	4.4	4.8
160	0	0.8	4.3	5.0
161	0	0.8	4.2	5.1
162	0	0.9	4.1	5.1
163	0	0.9	4.1	5.2
164	0	1	4.1	5.3
165	0	1.2	4.1	5.4
166	0	1.3	4.1	5.6
167	0	1.7	4.1	5.6
168	0	1.8	4.2	5.6
169	0.1	1.9	4.3	5.7
170	0.11	1.95	4.4	5.8
171	0.12	2	4.5	5.9
172	0.11	2	4.75	6.0
173	0.1	2	5.0	6.1
174	0	2	5.3	6.4
175	0	2	5.6	6.7
176	0	1.9	5.8	7.2
177	0	1.8	5.6	7.1
178	0	1.7	5.25	6.8
179	0	1.4	4.9	6.5
180	0	1.25	4.6	6.1
181	0	1	4.2	5.8
182	0	0.9	3.8	5.4
183	0	0.8	3.5	5.1
184	0	0.7	3.2	4.5
185	0	0.7	2.7	4.0
186	0	0.6	2.3	3.5
187	0	0.5	2.0	3.1
188	0	0.4	1.8	2.6
189	0	0.3	1.5	2.25
190	0	0.3	1.3	1.9
191	0	0.2	1.1	1.6
192	0	0.2	.9	1.3
193	0	0.1	.7	1.2
194	0	0.1	.6	1.1
195	0	0.1	.6	.95
196	0	0	.51	.85
197	0	0	.46	.77
198	0	0	.43	.72
199	0	0	.41	.69
200	0	0	.41	.69

* = L10 spread to approximately 1cm.

circuit board parts layout illustration (See Figure 1 on page 20).

Amplifier circuit board

GE part number 19D424309G1 is an intermediate power amplifier designed to amplify the oscillator-multiplier deck output to a nominal 10W.

This circuit board then drives a 110W final amplifier. In class C format, Q1's base is nearly a dc short to the emitter. With a maximum drive level of 20mW from a service monitor, it is necessary to re-bias Q1 somewhere closer to class A conditions. The pi networks are relied upon to keep the

output free of spurious emissions.

Replacing R13 with a 750Ω, ¼W resistor and placing a 1.5KΩ, ½W resistor from the junction of L3 and L4 to the base of Q1 gives interesting results. Other steps include replacing the 19A134340P3 transistor with a 19A134340P2 transistor. Removing the 51Ω R5 and rewiring the power lines to short Q215's collector and emitter leads, effectively removing the power control circuit, completes the modification (See Photo 1 on page 18).

Figure 2 below plots input voltage vs. output power for the modified board as measured at 5MHz increments

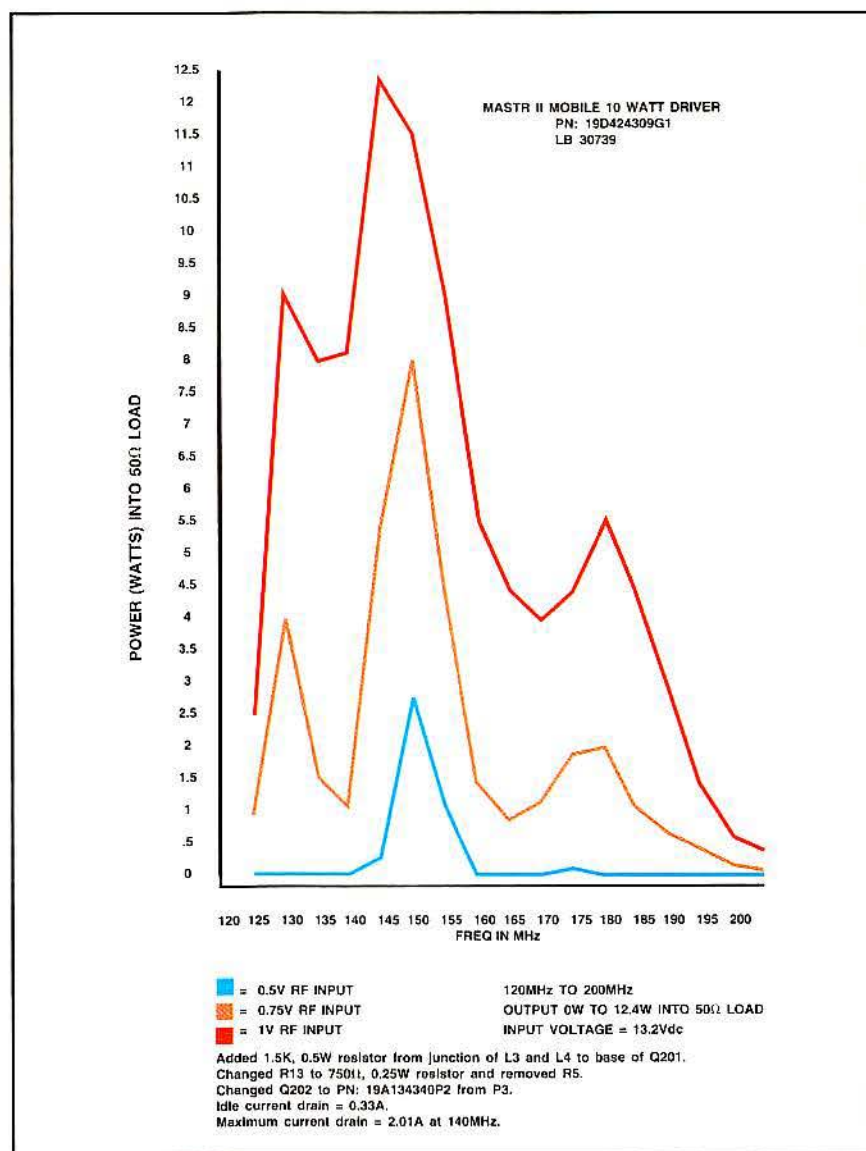


Figure 2. This graph shows input voltage vs. output power for the modified board as measured at 5MHz increments from 120MHz to 200MHz. The best performance is from 140MHz to 150MHz.

ments from 120MHz to 200MHz. The best performance is from 140MHz to 150MHz.

Table 1 on page 21 indicates the power output when operated at 13.2Vdc at 0.5V, 0.75V and 1.0V input signal.

The column marked with an asterisk shows performance with the turns of coil L10 spread to a distance of 1cm. The pi networks, and more specifically the collector load inductors, affect the amplifier's frequency response. To achieve better performance above the 140MHz-150MHz range, the turns of L3, L8 and L10 may be spread slightly.

When the transistor is re-biased closer to class A conditions, the quiescent (also called *standby* and *idle*) current increases. In this case, the idle current increases to 330mA, with a little more than 2A at 13.2Vdc drawn when the amplifier is driven to full output with a 1Vrms signal.

All tests were conducted using the VHF PA deck chassis. An equivalent heat sink would be needed for outboard

operation. A 5" × 5" × 0.25" heat sink has been found sufficient for five minutes of continuous operation.

Power control circuitry

The power control module and Q215 failed during some of the modification

Using the voltage values indicated in the schematic to calculate operating conditions, the potential problems the circuit poses are revealed.

experiments, so a discussion of these components is worthwhile.

GE part number 19D429709G1 performs several functions.

First, it senses the entire heat sink and chassis thermal conditions, acting as a thermally sensitive power controller.

Second, it has a standing wave ratio (SWR) sensor that cuts the output power when reflected power on the transmission line indicates an antenna problem.

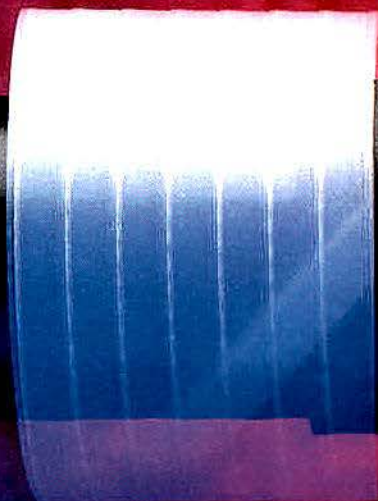
In either case, transistor Q215's base bias is adjusted by the hybrid, affecting the available voltage to both Q1 and Q2.

Using the voltage values indicated in the schematic to calculate operating conditions, the potential problems the circuit poses are revealed.

At Q215's collector is a nominal 12.5V; at the emitter, a nominal 5.5V. Across this transistor is a voltage of 12.5V - 7.5V, or 7V. With a current draw of 2A, this represents 7V × 2A, or 14W.

Collector voltage to both RF PA transistors is applied via this transistor. Even with intermittent use, the heat generated by the 14W dries the

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heatsink compound to a powder, rendering it less able to transfer heat to the underlying heatsink.

Two possible remedies are available.

*Reducing a power
amplifier's drive
requirements can be
achieved with some cut
and try methods . . .*

First, separate the emitter buss line to allow Q215 to control a single transistor, preferably Q2. A low-value resistor, around 10Ω at 10W, may be used to power the Q1 rail from the VCC source.

The other remedy is to pay closer

attention to the thermal transfer from Q215 to the heat sink. Remove *all* of the old compound and replace both the mica washer and the shouldered bushing (19A134016P1).

Remove the board and transistor, clean the solder joints, trim excess leads and apply new heat sink compound to the back of the transistor, both sides of the mica insulator and the mounting surface.

Leaving Q215's circuit board holes open, re-assemble the entire board to the chassis. Replace Q215 with a new unit, carefully guiding its leads into the circuit board, paying attention to the mounting screw alignment. If the screw and shoulder are misaligned, the plastic shoulder will melt as Q215 heats, eventually causing melt-through and a damaged transistor. Once the two are aligned, solder Q215's leads to the circuit board.

Wrap-up

Reducing a power amplifier's drive requirements can be achieved with

some cut and try methods as outlined above.

A common sense approach to transistor circuitry and attention to the basics yields similar results for anyone willing to try.

The same approach should work for any RF PA assembly that allows some room for modification.

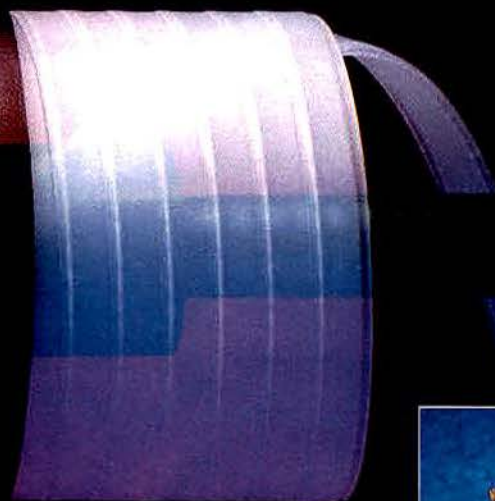
Acknowledgement

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The author thanks Ron Minor of Albany, GA, for assisting in the development of the modifications procedure.



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Radio troubleshooting: Go the extra mile

Checking supply voltage at the radio box connector during PTT helps to identify a grounding problem with a radio that may work fine on the bench and fail during transmit when installed in a vehicle.

By Mike Mekelburg

"Baaaa." The radio talk-prohibit tone rudely informed the technician

Mekelburg is lead technician at Confidential Communications Services, Flagstaff, AZ.

that the customer was right—something was amiss.

"I can't believe it!" the technician exclaims. "I ran this mobile on the bench for three days without a glitch. In the vehicle there's 13.8V right at the radio box connector, and the antenna system ohms out fine."

Sound familiar?

Certainly, intermittent failures always will be with us, but is there something more to check before "pulling the box to shop?"

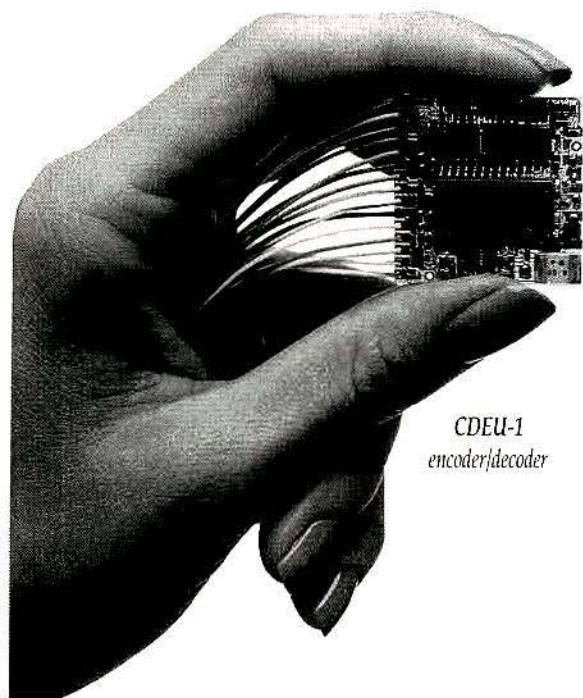
This lesson inspired an additional step in a mobile radio troubleshooting procedure.



Slide the 12V connector back slightly to measure voltage to the radio during push-to-talk (PTT). Specialized mobile radio (SMR) trunked radios may have to be put into test mode to obtain a PTT condition. The 12.1V reading is a typical measurement during PTT with the engine off.

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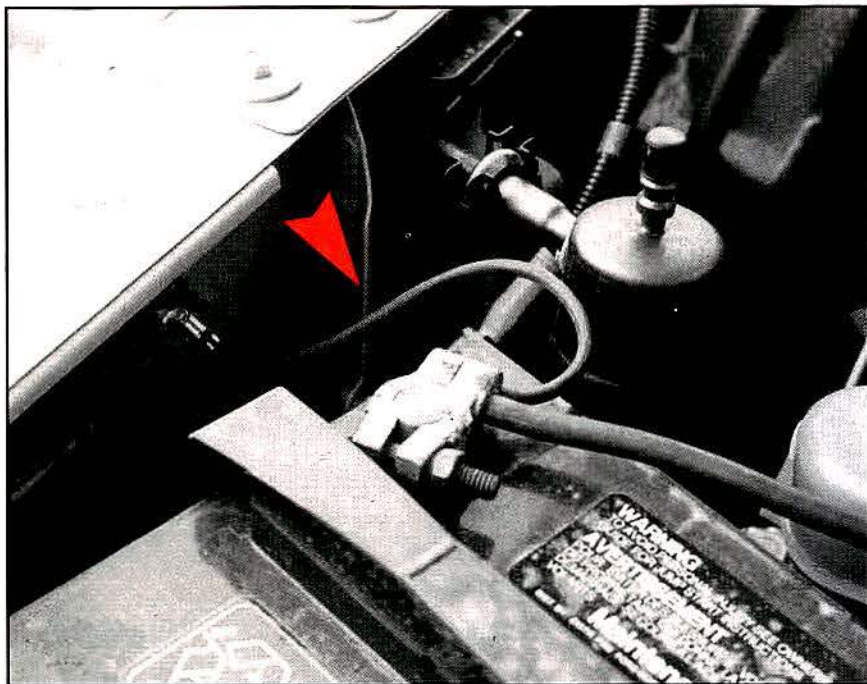
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A missing chassis-to-negative battery terminal connection (arrow) may cause the radio supply voltage to drop excessively during PTT. Many vehicle engine blocks are hardwired to the chassis, so not all vehicle models lose battery-to-chassis ground without the battery terminal connection.

Measuring 13.8V at the radio box connector is not conclusive. In one instance, the 13.8V plummeted to 7.5V during push-to-talk (PTT), even with the vehicle engine running.

The radio ground wire was secured to the vehicle chassis under the seat, and the red wire had good continuity to the battery with no corrosion or insulation breaks. The antenna coaxial cable was in good shape. (A blistered coax indicates bad radio grounding, with the coax shield acting as the only ground source.)

The problem was that, during a trip to the garage, the vehicle battery cable from negative terminal to chassis had been rerouted to the engine block only, effectively isolating battery ground from chassis ground.

This extra step of checking A+ at the radio box connector *during* PTT either points to a vehicle wiring defect or allows the technician to pull the box to shop with a clear conscience.



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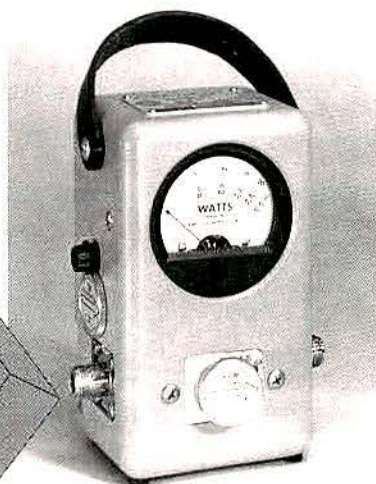


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New Law, new age: Commercial Mobile Service

Radio spectrum lotteries are out; auctions are in. Common carriers gain a little; private carriers lose a lot. Changes in the Communications Act give common carrier and private carrier system operators much to consider.

By Robert H. Schwaninger Jr.

For the past few years, radio common carrier paging system operators (RCCs) have been grouching about the encroachment into their traditional markets by the upstart private carrier paging system operators (PCPs).

The RCCs would tell anyone who would listen that "we've got to file tariffs, deal with the state Public Utilities Commissions (PUCs) and comply with a bunch of laws that private carriers are free to ignore. It's not fair!"

Thanks to the Omnibus Budget Reconciliation Act of 1993 (the *New Law*), the RCCs' dream of regulatory parity has mostly come true. On Aug. 10, 1993, President Clinton signed into law sweeping changes in the Communications Act that will change radio spectrum management by balancing the interests between RCCs and PCPs.

For RCCs, the world of regulation has become a lot easier. For private carriers, the world has become considerably more complex.

The New Law has created a new category of service provider known as *Commercial Mobile Service* (CMS) that includes "any mobile service that is provided for profit and makes interconnected service available to the public." All CMS operators will be subject to the provisions of Title II of the Communications Act, which formerly

controlled only the activities of common carriers.

Common carrier regulation

Now, private carriers that provide interconnected service will be regulated as common carriers. That includes private carrier paging system operators, private carrier two-way radio system operators and specialized mobile radio (SMR) system operators.

The New Law reads that if your

some regulators believed were best left alone. Most important is the definition of *interconnected service*.

FCC Part 90 rules appear to preclude many forms of interconnection that, nevertheless, exist in the marketplace. Most notable is interconnected private carrier paging. When PCP service started, RCCs argued that the service was impermissibly interconnected under the FCC Rules, and that PCPs should be required to use only operator-assisted paging.

In a mostly private-letter decision issued in 1983, the Private Radio Bureau declared that a paging terminal's store-and-forward function is sufficient to *deny the existence of interconnection* for these systems.

Over the years, the FCC has admitted that PCPs are, in fact, interconnected, and licenses granted today carry the "C" designation for interconnection. The problem is that the FCC never has defined interconnection clearly.

This problem is exacerbated by the myriad of private radio rules that often penalize operators for providing interconnected service, including the requirements that operators obtain consent from other carriers or take their license on a secondary basis to traditional dispatch services.

Interconnection rules

One likely consequence of the New Law might be the airing of the interconnection rules under Part 90, which might lead to a clearer definition of interconnection. It is clear that the FCC is going to be compelled to move in

*... the FCC never has
defined interconnection
clearly.*

existing service is defined as a CMS system, the service will be deemed to be common carriage as of 1996. This three-year grace period applies to pending applications as well. All new systems that are applied for following Aug. 10, 1993, are deemed to be common carriers immediately.

Defining CMS

The definition of Commercial Mobile Service contained in the New Law is not as simple as it might first appear.

The FCC still will have to wrestle with questions that long have been rattling around the commission and that

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC.

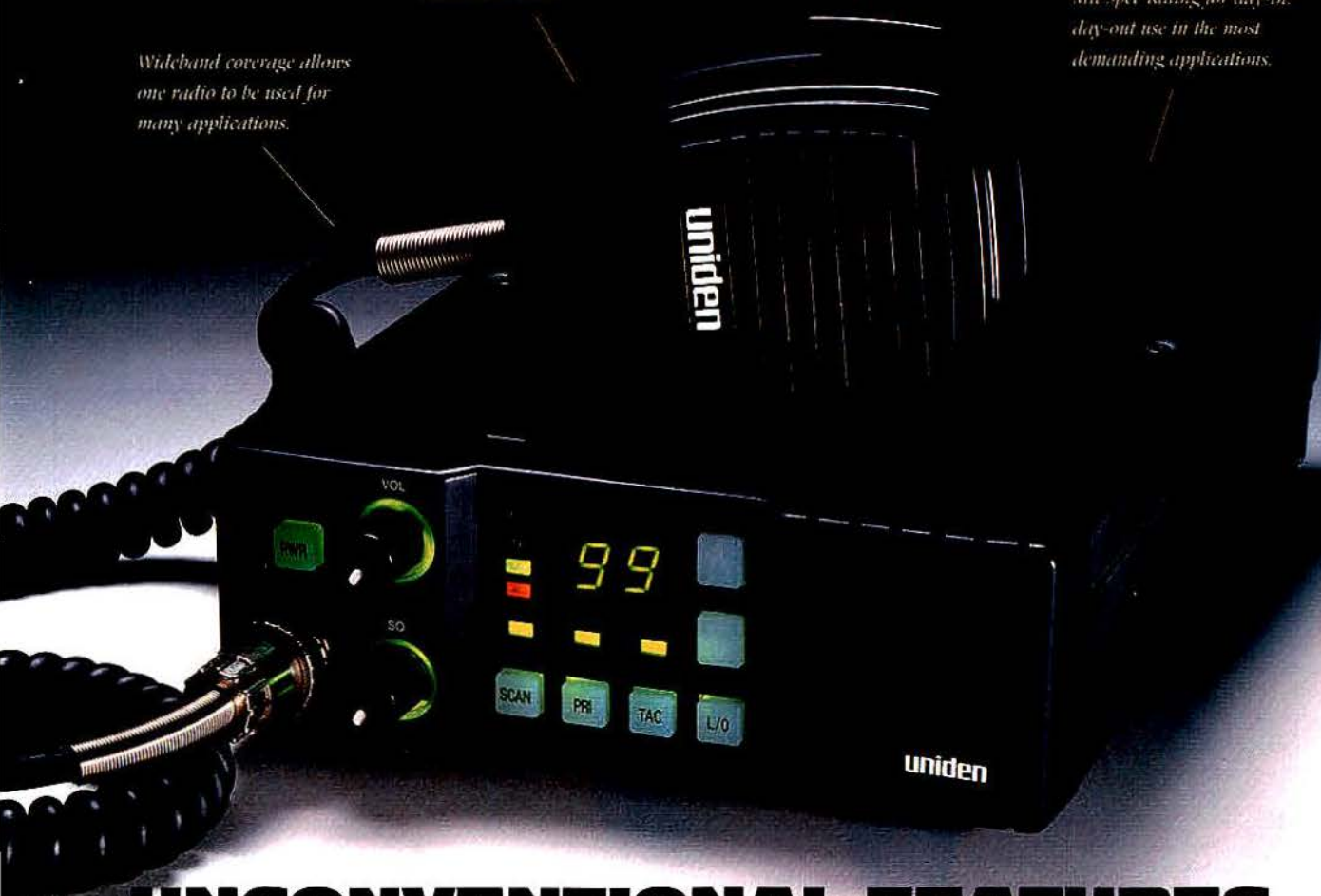
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this area so that a brighter line will exist between private operators and CMS operators.

The second element of the definition of CMS that requires that the service be made "available to the public" might also reap headaches for the FCC. What about the private carrier who is providing service to only a single class of subscribers?

For example, ProNet long has used public safety frequencies to service hospitals and medical service employees. Will the company's one-class service be considered "available to the public?"

How about cooperatives?

Then there is the problem of operators with licenses for private carrier facilities that serve only one large user

on the channel, often with an agreement that no other subscriber will be loaded onto the channel. Will the impact of these systems create an ever-graying area into which large numbers of private operators will slip to avoid new regulation?

In doubt? Call it CMS

The New Law appears to be more *inclusive* on this issue than *exclusive*. Additional language reads that entities that provide service to a "substantial portion of the public" also will be deemed CMS operations, including those owned by cooperatives. It appears that Congress has stated, "when in doubt, it's a CMS system."

The task of identifying which services are "available to the public" will

Reallocating federal spectrum

The Omnibus Budget Reconciliation Act of 1993, signed into law on Aug. 10, 1993, requires the federal government to make available for civilian and public use 200 megahertz of radio spectrum located below 5,000MHz.

The specific spectrum to be made available will be identified in accord with the following criteria:

(a) to what extent the federal government might rely on commercial providers for certain services.

(b) what spectrum might become available due to the introduction of new technologies.

(c) the use of non-radiating communications systems, when practical.

(d) excessive costs to the federal government.

(e) excessive disruption of government services.

To further identify the bands to be recommended for reallocation, the Secretary of Commerce will consider the feasibility of use of the bands by commercial users, including whether equipment is readily available to utilize the band, whether commercial users are occupying spectrum in close proximity and whether reallocation might stimulate development of new technologies.

The Secretary of Commerce's ini-

tial recommendations shall occur within six months from the date of enactment of the Omnibus Budget Reconciliation Act. Contained within the initial report shall be recommendations for immediate reallocation of at least 50 megahertz of radio spectrum located below 3,000MHz, with no band of frequencies equal to less than 25 megahertz. The public will be provided opportunity to comment to the recommendations.

Within one year after receipt of the recommendation, the FCC shall submit a report to the President and Congress consisting of a plan for the allocation and assignment of the reallocated radio spectrum. The plan shall include a gradual, 10-year allocation of the spectrum made available.

In the event that reallocated radio spectrum assigned by the FCC later is found to be necessary for federal government operations, the federal government shall have the authority to demand reassignment of such spectrum to its uses. If such reassignment is made, returning assigned spectrum to the federal government, the federal government shall bear all costs of displacing licensed users.



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also nag the FCC as it comes to grip with the New Law. This task is made even harder by the language of Title II of the Communications Act, which reads that operators must provide service to anyone requesting such service. Therefore, if a private carrier that provides service only to one subscriber or one class of subscribers is found to be a CMS operator, that CMS operator

then must open its doors to all comers.

The FCC has a year to work out the details of what exactly constitutes a CMS operator. I suspect that the FCC will employ the "if it looks like a duck . . ." theory to the whole business.

Interconnection is likely to be defined as all services that use the telephone network in the delivery of serv-

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ice, no matter where the connection to the network occurs, as long as the connection process is not interrupted by a human operator.

As for the question of public availability, the FCC probably will adopt rules that are broad in scope and let licensees explain why they should not be designated as CMS operators.

Shackling the states

Although Congress has created a new class of common carrier, the New Law giveth as well as taketh.

State governments are barred from regulating rates and entry of common carriers. Aside from putting a lot of PUC attorneys out of work, this portion of the New Law will lighten the load for existing common carriers as well as CMS operators.

No longer will common carriers be forced to file tariffs with state PUCs or to obtain a *certificate of convenience and necessity*.

Well, that might be taking things a bit far. What Congress stated was that rates and entry would not be regulated. It left the states free to regulate other elements of common carriage such as universal access, taxation, billing practices, advertisement, rights of way and a myriad of other issues. But it appears that the two most vexing areas for common carriers have all but been

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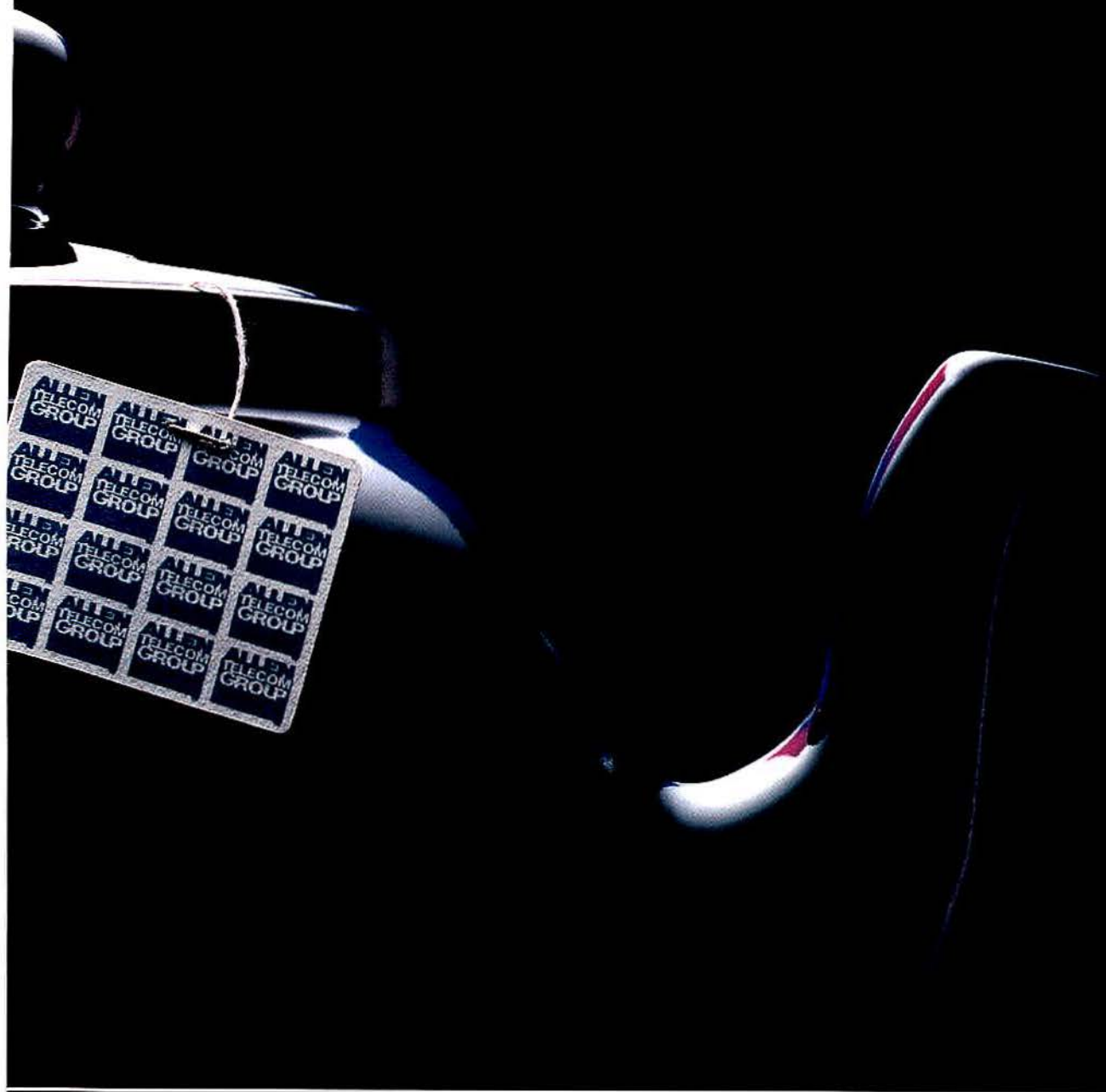
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eliminated from consideration by the states.

Easing tensions

Anyone familiar with the tug-of-war going on between the California PUC and cellular carriers should see this as a way of easing tensions. States such as Georgia, which long has had entry regulation that creates enormous market shares for a few dominant players, now will be open for others. One can expect that the ease of entry into traditionally closed markets will be met with increased competition.

One area in which CMS operators are likely to see a difference in their relationship with the states is taxes. Traditionally, many states have applied one tax to common carriers and another to private carriers.

State excise taxes designed to grab a piece of the action from utilities are likely to apply to CMS operations. Newly created CMS operators are, therefore, encouraged to pay a visit to their certified public accountant (CPA)

to see whether they should collect additional taxes from subscribers to give to the states.

Finally, since the FCC lost a court battle in which all non-dominant com-

Long the sacred cow of private radio and, particularly, SMR operations, the deified bovine of dispatch services will not be sent to the slaughter house by the New Law.

mon carriers were made exempt from filing tariffs with the FCC, the agency has been forced to accept tariff filings from all common carriers. Given the language of the New Law, expect that CMS operators will be compelled to

file tariffs with the FCC as well.

On the other hand, given the fact that private operators always have been able to engage in subjective setting of rates, one has to wonder whether tariffs, as they are traditionally thought of, are even possible for CMS.

Dispatch services

Long the sacred cow of private radio and, particularly, SMR operations, the deified bovine of dispatch services will not be sent to the slaughter house by the New Law.

The line between traditional common carriers and private operators remains intact. The New Law prohibits common carriers licensed on RCC frequencies after Jan. 1, 1982 B.C. (before cellular) from providing dispatch services.

These prohibitions were considered vital by SMR operators, and the American Mobile Telecommunications Association (AMTA) lobbied hard to maintain them.

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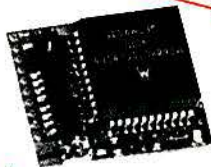
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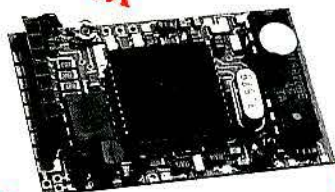
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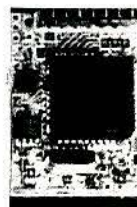


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Mind you, there is a practical question of whether it ever was cost-effective for a cellular operator to offer dispatch services, and most RCCs long had abandoned any hope of employing improved mobile telephone service (IMTS) channels for dispatch.

Still, SMR operators' marketplace, including the introduction of enhanced SMR (ESMR) services, led AMTA to

exercise caution. As the SMR coffers continued to swell from sales of dispatch plus interconnected service, some SMR operators believed that they were ripe for competition from traditional common carriers, including cellular systems.

One important caveat should be noted. Although Congress stated a strict prohibition against common car-

riers providing dispatch services, the language of the New Law also states that the FCC can lift the prohibition by rule. Put another way, Congress maintained the status quo and shifted the battle to the FCC.

America first

As anyone who has ever filled out a common carrier application knows, the FCC long has prohibited foreign ownership of RCCs.

If more than 20% of an RCC's stock were owned by aliens, it had to be reported and approved. One could say that RCC operations are one area where the FCC has always taken to heart the "Buy American" slogan.

With the creation of CMS, Congress has extended its domestic preference to include the new class of carriers, setting restrictions on CMS operators with at least 20% foreign ownership.

This extension of a domestic preference to CMS operators will create problems for some alien-owned private carriers. Seen by some as a method of avoiding the RCC prohibition, private carriage has flourished in some areas because of Eurobucks and some Australian out-backing.

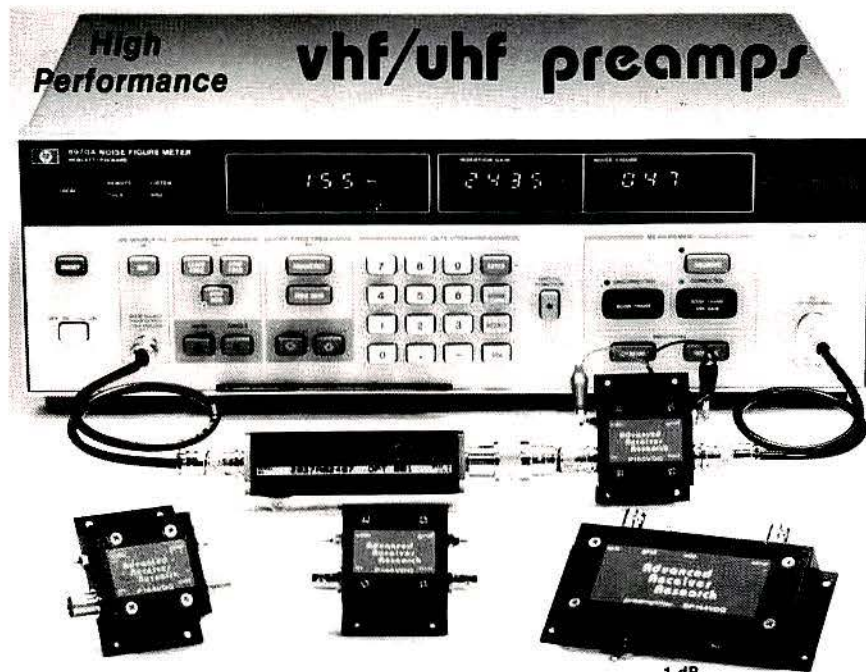
It appears that Congress has closed the loop-hole and has decided that CMS will not be subject to foreign competition.

Waiver

Before you rush to dump all of your stock in NipponDeucht-AussieComm Inc., you should recognize that the New Law does not take away the assets of existing, foreign owned, private carriers. Foreign companies that were private carriers prior to May 24, 1993, and that will become CMS operators, are exempted from the new restriction.

These companies must file for a waiver of the new restriction by Jan. 10, 1994; they cannot increase their percentage of foreign ownership; and they cannot assign their foreign interest to another foreign entity. In other words, Congress said that foreign companies can keep what they have, but they cannot have any more.

The new restriction appears to apply to *company ownership*, too. It is not clear whether a foreign-owned entity can apply for additional frequencies



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	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	Comp. (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95

Inline (rf switched)

SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$139.95

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for CMS operations, though there is great doubt.

They probably will be allowed to expand existing systems on the same frequency for which they are presently licensed. The question left unanswered is, How will the states deal with newly created, foreign-owned utility (common carrier) companies? No matter how you scrutinize it, it appears that foreign-owned companies are in for a regulation-ridden ride in CMS operations.

Cash-and-carry

The New Law has made spectrum auctions a reality for subscriber-based services.

This definition does not include traditional broadcast facilities that do not serve *subscribers*, only *viewers*; nevertheless, licensees of common carriers, including CMS, personal communications services (PCS), personal communications networks (PCNs), location monitoring services (LMS) and a host of other tri-lettered services

should take note. The days of stuffing the ballot box with lottery applications has come to an end. Now, the FCC will be using competitive bids to award licenses.

Although the New Law has opened the door to spectrum auctions, Con-

*The days of stuffing the
ballot box with lottery
applications has come to
an end.*

gress has left a lot of room for the FCC to maneuver in this area. Exactly how the FCC will assure that minority businesses, small entrepreneurs, and other underheeled concerns will be provided with an opportunity to participate is not clear.

Congress wants the FCC to make

sure that auctions are not solely the purview of the largest and the richest. In fact, the New Law states that the FCC should act to avoid concentration of licenses among a discreet group of operators.

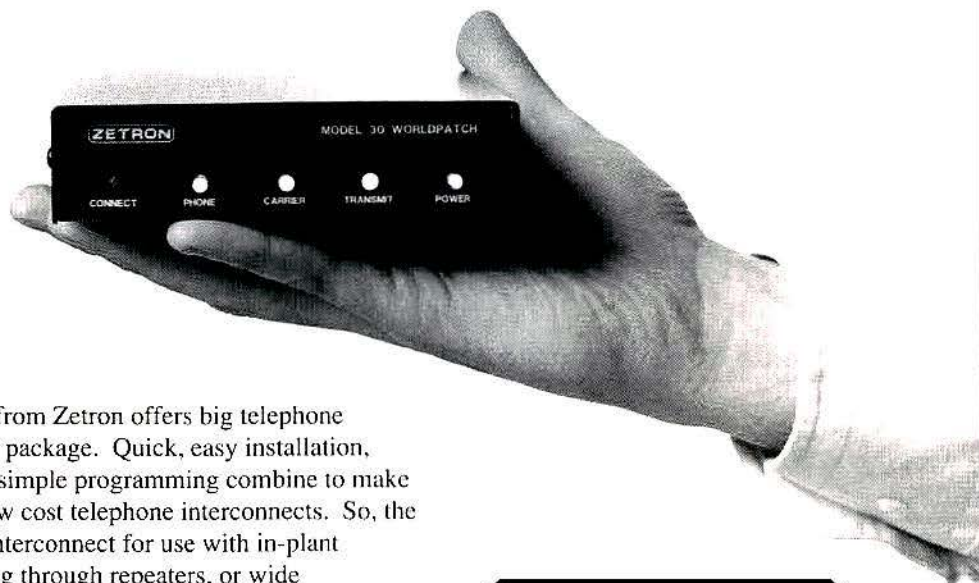
Payment plan

The New Law suggests methods of structuring payments so that smaller entities and rural entities will be able to afford participation in future auctions. It further states that the FCC may not base its decisions solely or predominantly on the amount of money to be made. In this way, Congress is telling the FCC to get a return on the radio spectrum, but the agency does not have to maximize potential revenues.

The New Law does not prevent the FCC from ever using lotteries. Mini-lotteries between small numbers of mutually exclusive applications may continue. It is hard to visualize a bidding process between two applicants for 152.800MHz in Fargo, ND.

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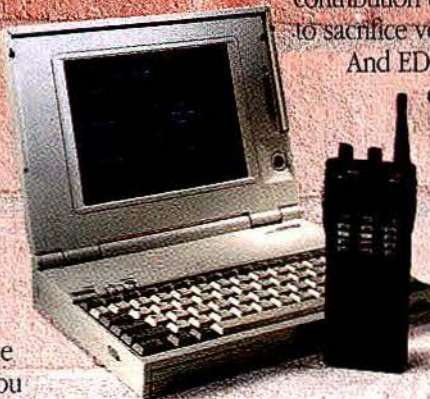
instantly if an important machine is malfunctioning. It can even monitor equipment as far as 100 miles away, making sure it's operating safely. That's a significant contribution to productivity – without causing you to sacrifice voice communications.

And EDACS' modular building block design is easily expanded. So your system won't become obsolete, but can be modified as your needs change.

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So, the FCC's amortized investment in ping-pong balls for the lottery selection drum probably will continue to be useful. What the new spectrum auction authority is designed to handle is initial licensing, which is directed at a new service offering.

A first for PCS

If you are wondering which service might be the first to be affected by spectrum auctions, you might want to bet on PCS. Congress set a 180-day deadline on the FCC to come out with a final order on whether the introduction of PCS will improve competition in the marketplace and to establish PCS rules.

Congress also mandated that the FCC must begin issuing permits and licenses for PCS within 270 days of enactment of the New Law.

To further offset the FCC's shortfall of resources, Congress has enacted annual *regulatory fees* that range from \$7 per license for a private, shared-use service, to \$90,000 per year for low-

orbit satellites.

Oddly, there is no category on the published schedule for CMS operations. It appears then that CMS operators will pay the same rate as traditional private operators, \$7 per year per license if on shared spectrum and \$16 per year per license if employing an exclusive channel.

*... it is up to the FCC
to decide how to use
and how to enforce its
new authority ...*

Traditional common carriers licensed under Part 22 will pay an annual fee of \$120 per each 1,000 subscribers. Cellular operators will pay \$60 per 1,000 subscribers, as will PCS operators. Governmental entities, non-

profit entities and amateur radio operators are exempt.

Congress has empowered the FCC to raise or decrease the annual fees on its own motion. Future changes are not subject to judicial review. The idea is to enable the FCC to calculate the costs of operation and to collect annual fees to cover such costs.

In fact, the collected fees are to be placed in a special account for the FCC's use and are not to be deposited in the general treasury; nevertheless, the language falls short of enabling the FCC to keep everything it collects. Congress still will appropriate money for FCC operations and will disburse the collected fees.

The FCC's turn

Presumably, Congress is done with its telecommunications work for the foreseeable future.

The New Law contains many elements that the FCC has wanted for a long time, including spectrum auctions, annual fees, special accounts for determining future appropriations, relief from the nightmare of lotteries and other substantive assistance. Now, it is up to the FCC to decide how to use and how to enforce its new authority, how to define many vague terms and procedures that appear in the New Law and how to superimpose the changes in the Communications Act upon its existing regulation.

Perhaps the FCC's job has been made more difficult because of the two pending dockets to rewrite Parts 22 and 90. Certainly, one could argue that the earlier comments received in those dockets no longer apply, given Congress' recent acts. It may well be that the FCC will have to start fresh on those dockets and others or risk a court battle as to whether adequate notice was provided to the commenters.

It is hard to discern the full ramifications of the New Law. Interpretation, litigation, new procedures, auctions and technical innovation might change the manner in which all affected people view what has been adopted.

It may be years before the recently adopted language becomes comfortably defined. And by then, you can be assured that Congress will be ready to act again.

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The COM-120A



1993

Technically speaking

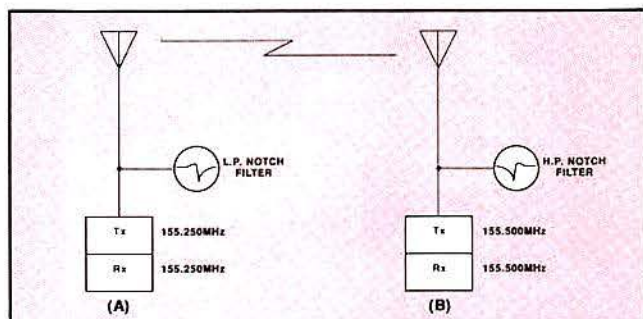


Figure 4. Two simplex base stations operated in close proximity and at "close-in" frequency spacings can cause serious interference with each other. Here, a low-pass notch filter is used at base station A while a high-pass notch filter is used at base station B to minimize interference between the two stations. The notch filter on base station A passes the 155.250MHz signal while rejecting the 155.500MHz signal from station B. The notch filter on station B passes the 155.500MHz signal while rejecting the 155.250MHz signal from station A. Both notch filters also help to reduce transmitter noise interference on both ends. (See text.)

(continued from page 8)

cavity using a 3.0dB coupling loop.

Figure 3 on page 8 shows the improved selectivity gained by cascading three cavities. The -20dB points occur at less than 300kHz from the center

frequency. At 450kHz from center, the attenuation is 30dB. This filter arrangement can do a fairly respectable job of filtering both the receiver and transmitter.

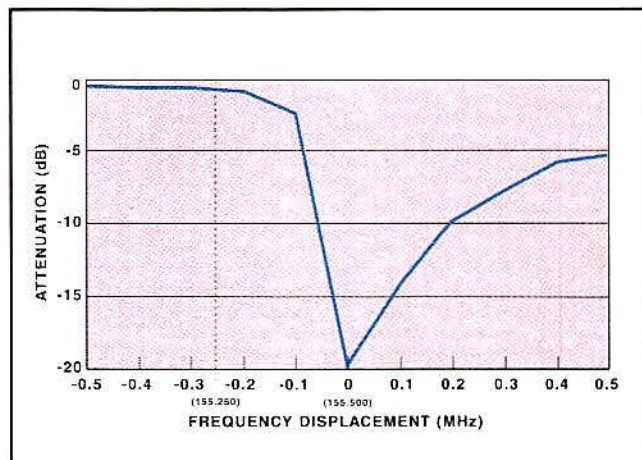
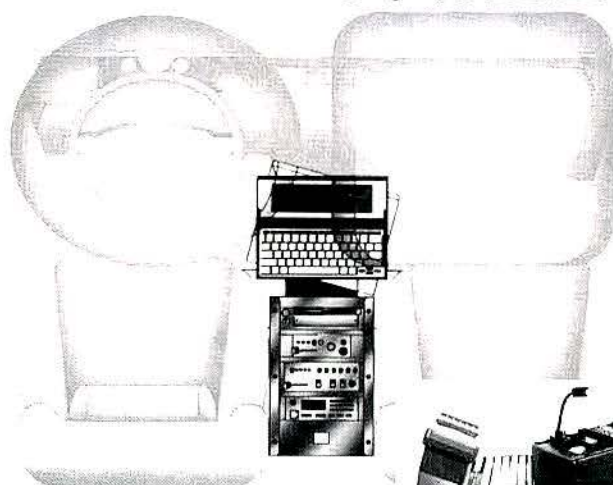


Figure 5. This frequency response curve represents the low-pass notch filter installed on station A in Figure 4. It has a low insertion loss at the desired frequency (155.250MHz) and high rejection at 155.500MHz.

Band-reject or notch filters are highly useful when it is necessary to filter out a single undesired signal that is quite close to the desired signal's frequency.

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Technically speaking

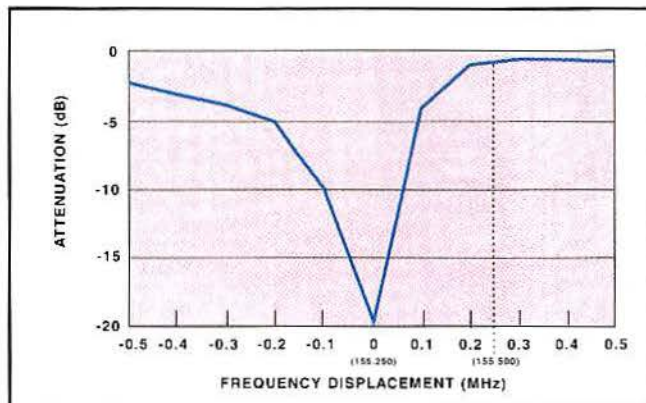


Figure 6. This frequency response curve represents the high-pass notch filter installed on station B in Figure 4. It has a low insertion loss at 155.500MHz and high rejection at 155.250MHz.

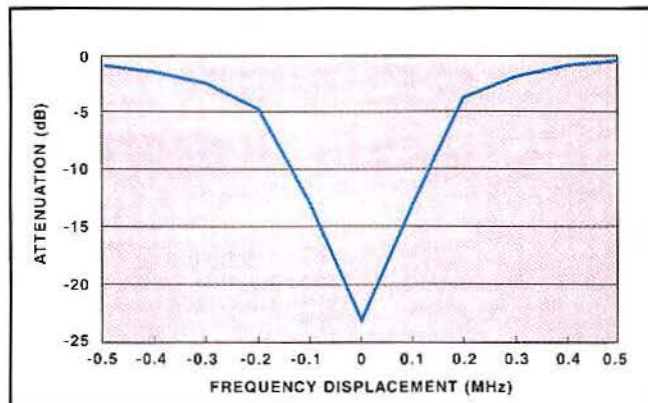


Figure 7. The frequency response curve of a symmetrical notch filter. At wider frequency separations the insertion loss is smaller and the rejection is greater than for a comparable high- or low-pass notch filter.

The object is to attenuate severely the undesired signal while causing as little attenuation as possible to the desired signal. When the frequencies are as close as a few hundred kilohertz in the VHF highband range, a bandpass filter would not provide the necessary selectivity to reject the undesired

signal.

Notch filters can be classified as symmetrical, high-pass or low-pass. Each type has its special applications. Figure 4 on page 44 depicts a situation where two simplex base stations are operating at close frequency spacing at the same communications site—one

at 155.250MHz (A) and the other at 155.500MHz (B).

Sideband noise from either transmitter can interfere with the other receiver. Because the frequency spacing is only 250kHz, a bandpass filter would not help. The solution is to install a notch filter on each base station.

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Table 1—Comparison of dual-cavity high-pass notch filter response and the response of a symmetrical notch filter at various frequencies.

FREQUENCY SEPARATION (MHz)	DUAL-CAVITY HIGH-PASS NOTCH ATTENUATION (dB)	DUAL-CAVITY SYMMETRICAL NOTCH ATTENUATION (dB)
0 (NOTCH)	-42.5	-52.0
+0.25	-1.1	-7.0
+0.500	-0.5	-0.8
+0.750	-0.4	-0.3
+1.000	-0.7	-0.3
+2.000	-1.7	-0.3
+3.000	-1.7	-0.3

To minimize the interference, a low-pass notch filter is installed on base station A, and a high-pass notch filter is installed on base station B.

Figure 5 on page 44 is a graph of the frequency response of the low-pass notch filter installed on base station A. The deep notch at 155.500MHz attenu-

ates the transmitter sideband noise (from A) that might interfere with receiver B.

The insertion loss at the desired frequency (155.250MHz) is quite low, less than 1dB. Notice that the notch filter is common to both the transmit and receive line, so it does double duty

Notice that the notch filter is common to both the transmit and receive line, so it does double duty in solving the interference problem.

in solving the interference problem.

In the transmit mode, it filters out sideband noise that might interfere with receiver B. (The only place to filter out sideband noise is at the offending transmitter.)

In the receive mode, it filters out the strong signal (155.500MHz) from transmitter B. Otherwise the strong signal from transmitter A might cause serious receiver desense. (The only place to filter out signals causing desense is at the affected receiver.)

Figure 6 on page 46 is a graph of the

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frequency response curve of the notch filter connected to base station B. The deep notch at 155.250MHz attenuates transmitter sideband noise that might interfere with receiver A.

At the same time, the filter would attenuate the strong 155.250MHz signal that might otherwise cause receiver desense at receiver B. Thus, both notch filters serve a dual function to solve receiver desense and transmitter noise interference problems.

Symmetrical notch filters

When the desired frequency or frequencies are widely separated from the undesired frequency, a symmetrical notch filter can be used. Figure 7 on page 46 is a graph of the frequency response of a typical single-cavity symmetrical notch filter. Note that, unlike the high- or low-pass notch filter curves, the upper and lower frequency responses of the symmetrical notch filter are almost mirror images of each other.

There are other important differ-

With high- or low-pass notch filters, the insertion loss increases at frequencies further removed from the notch frequency.

ences between the symmetrical and high- or low-pass notch filters. With high- or low-pass notch filters, the insertion loss increases at frequencies further removed from the notch frequency.

The high- or low-pass notch filter causes lower insertion loss at "close-in" frequencies. The symmetrical notch filter is just the opposite—it causes more insertion loss at "close-in" frequencies and less insertion loss at frequencies further removed from the notch frequency.

Furthermore, the symmetrical notch filter provides greater attenuation at the notch frequency than the high- or low-pass notch filter.

The choice of symmetrical or high/low-pass notch filter depends upon how much attenuation is needed at the notch frequency and how much insertion loss the system can tolerate at the desired frequency.

Table 1 on page 48 lists insertion loss at various frequency separations for a dual-can high-pass notch filter and a dual-can symmetrical notch filter.

Now, suppose that you need to notch out an interfering frequency that is 250kHz below the desired frequency with minimum insertion loss at the desired frequency. The high-pass notch filter produces an insertion loss of 1.1dB at the desired frequency, and the symmetrical notch filter produces an insertion loss of 7dB at the desired frequency.

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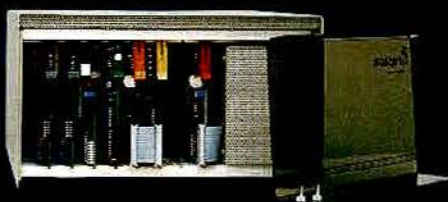
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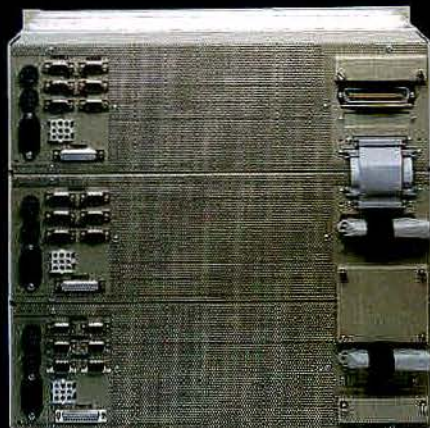
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The Page Maker 8 is identical to the Model 15 except that the left seven card slots have been removed. This terminal was designed for smaller markets, on-site paging, or special applications.



To expand beyond the Model 15, just add chassis and ribbon cable them together.

The key to our remarkable expansion ability is simple: All Unipage systems operate with the same cards and software. The smallest system has all of the features and capacity of the largest. A model 15 can be expanded to 60 card slots by adding chassis.

More and more paging companies are switching to Unipage. In this dynamic market in the last two years, over 40 companies who owned terminals manufactured by our primary competitors, have purchased Unipage systems.



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Is Limited By gination

Our flexible card design allows a system to be built with only seven types of cards. This reduces spares cost and simplifies system maintenance.



When a single frame becomes full, just add more frames to build a system that is limited only by your imagination.

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And our new 32 bit 68040 Main Processor takes our processing power to new horizons. Processing up to 200 calls per second, it expands our capacity far beyond the limits of our competition.

As Unipage adds new features and hardware, future compatibility is assured. The unique system architecture provides for simple enhancements as your needs evolve. Unipage systems can even be used in conjunction with the Motorola MPS 2000.

The LiaoNing province wide terminal is a 560,000 subscriber, 14 city distributed system.

Call your paging sales representative.

If you are considering a paging system, we'd like to tell you more about our products and services. Just give us a call today, and we can show you how easy it is to expand your Unipage system.

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Technically speaking

The choice is obvious—the high-pass notch filter.

Suppose that the undesired frequency is 500kHz below the desired frequency and that maximum rejection at the notch frequency with less than 1dB insertion loss is needed at the desired frequency. At the notch frequency (0) the symmetrical notch filter provides 52dB of rejection while the high-pass notch filter provides only 42.5dB of rejection.

The high-pass notch filter has an insertion loss of 0.5dB at the desired frequency, and the symmetrical notch filter has an insertion loss of 0.8dB at the desired frequency. For a difference of 0.3dB insertion loss, the symmetrical notch filter provides almost 10dB

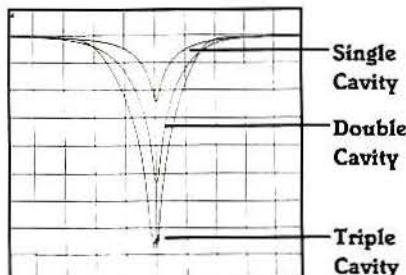
There is much more to filters than can be presented in this small space; nevertheless, this information should give you a good idea of what can be done with cavity filters.

TUNABLE NOTCH FILTER

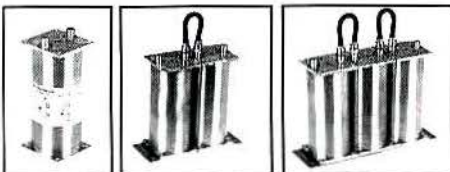
The 6367 series comprises 6 separate tunable notch filters, each of which covers an approximately 2:1 frequency range with adjustable 3 dB bandwidth. A coaxial or helical resonator is tuned with high Q air trimmers to produce a relatively deep notch at narrow bandwidth. Available for tuning ranges of:

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- 30 - 50 MHz
- 50 - 108 MHz
- 108 - 216 MHz
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- ☐ electroluminescent display for easy viewing night or day
- ☐ licensed CLEAR CHANNEL LTR® testing capability
- ☐ memory cards to load and run tests automatically, including all cellular formats
- ☐ digital storage oscilloscope
- ☐ internal battery

Lighten your two-way test load today—call for more information on the STABLOCK 4015:

1-800-225-5765 (in MA: 508-671-9700).

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Circle (42) on Fast Fact Card

Eagle Satellite acquires Paging Products International

Paging Products International, Houston, and Eagle Aerospace, Houston, are forming a telecommunications company as the result of the acquisition of Paging Products International by Eagle Satellite, a wholly owned subsidiary of Eagle Aerospace.

The new company will retain the name Paging Products International and will expand the range of products and services offered to the telecommunications indus-

try on a worldwide basis. Included are all brands of paging base station products; paging support products; cellular and PCS products; worldwide system engineering and installation support; satellite-based system design, installation and support; and custom product services.

The address is 9829 Telephone Road, Houston, TX 17075; phone 713-991-4930; 800-628-3910.

Metricom secures \$4 million UtiliNet order

Metricom, Los Gatos, CA, has secured a \$4 million UtiliNet purchase order from Southern California Edison, Rosemead, CA, which is expanding its use of Metricom's wireless data communication technology from pilot to large-scale projects. UtiliNet allows a utility company to communicate data throughout its service area with a network of wireless, packet-switched radios. The order covers products that will be shipped to Southern California Edison through March 1994 to expand the conservation voltage regulation program.

Metricom has also been awarded a contract to supply approximately 200 UtiliNet network radios to the Metropolitan Sewer District of Cincinnati. The network will link 170 remote terminal units to central and regional master computers in Cincinnati's service area.

Teleflex relocates to Greensboro, NC

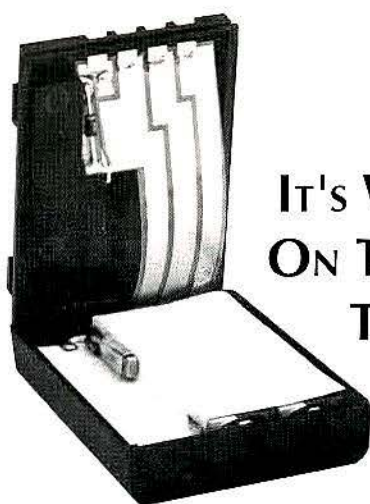
Teleflex Information Systems' anticipated growth has spurred the move to 17,000 square feet of office space that will house 60 employees and six departments. The departments will include a high-tech training unit, stationary porting lab for testing and areas for administrative, marketing, development and support. The address is 7736 McCloud Road, One Triad Center, Suite 100; Greensboro, NC 27409-9324; phone 919-605-3100.

NDS to install Florida AVL, mobile data system

Harris, Melbourne, FL, has contracted Navigation Data Systems, New Orleans, to install a GPS-based automatic vehicle location and mobile data system on more than 800 transit vehicles in Dade County, FL. The contract is part of a project to install an Ericsson GE Enhanced Digital Access Communications System (EDACS) covering the 1,955 square mile area, including Miami.

The NDS Fleet-Trak 1000 system will feature 16 dispatcher work stations installed at several locations and interfaced to the radio network using three sites for data transmission.

NDS Fleet-Trak mobile equipment will be installed on 800 to 900 transit vehicles, including buses, light rail, people movers and supervisory and administrative vehicles. The mobile units will feature an advanced transit control head that displays the dispatcher-originated messages and operator-entered data, including route/run and status information.



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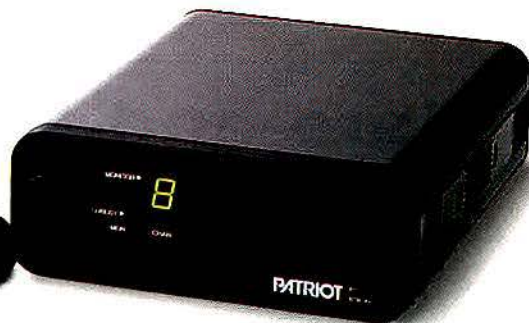
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Synthesized, Field Programmable
16 channels
30 Watts VHF 25 Watts UHF
Frequency Bands: 136-174
400-430, 450-512 MHz
Wide Band Operation:
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*Portable comes with: battery, antenna, wall charger and belt clip.
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support from the factory. It's true we have Patriot radio dealers worldwide, but right now a limited number of dealerships are still available. So take advantage of a truly patriotic deal, and call us at 1-800-USA-1-USA. **PATRIOT**
FAX: 317-846-4978. **BY RITRON**

Lotteries: A bad idea whose time has passed

By Robert H. Schwaninger Jr.

If you've been part of the telecommunications business for the past ten years, it's likely that at some time you've been contacted by some outfit promising to give you the opportunity of a lifetime.

All you had to do was to pony up about \$5,000, and you would own a part of an FCC application that might be selected for a valuable license. For \$10,000, you'd become a member of the Silver Circle, entitling you to a bigger piece of the pie and other wondrous considerations.

For \$20,000, you could join the society of the Gold Circle, complete with passwords, secret handshake and actual printed documents suitable for framing. Finally, for just a few thousand dollars more, they would send you the decoder ring. With it you could calculate your chance of cashing in on these investments. Inside the ring's

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC.

secret compartment was Dr. Kevorkian's phone number.

These get-rich-quick houses, usually referred to as "application mills," have been known to file dozens of applications for the same license in the same lottery. The concept of *conflict of interest* was foreign to them if it slowed down the flow of investments.

It's hard to imagine an auction system that will not somehow favor the deepest pockets.

As for whether the applications actually were prepared correctly, many people will never know because they never saw the paperwork, and their application wasn't selected among the thousands of others in

one of the FCC's random drawings.

Boiler rooms

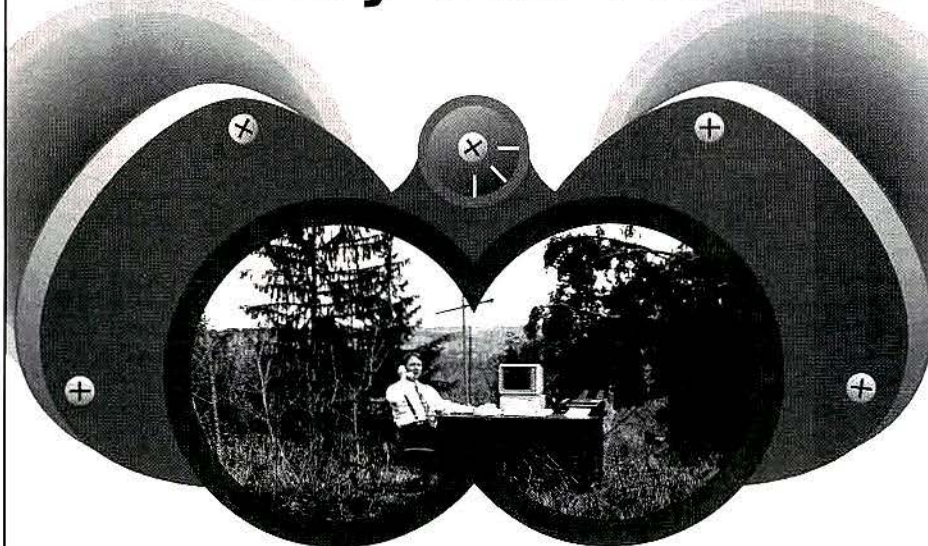
With the new law passed by Congress and signed by President Clinton on Aug. 10, 1993, these boiler room hucksters are going to have a more difficult time luring the uneducated into the game. The changes in the Communications Act will make the use of lotteries for new spectrum a thing of the past. Instead, the FCC will auction spectrum.

If your sensibilities place you in the anti-auction camp, reasonable people might agree with you. It's hard to imagine an auction system that will not somehow favor the deepest pockets.

On the other hand, for those serious operators who had the resources, ability and experience to construct a system employing the latest technology and who then watched the license being granted to an investment cartel of dentists, maybe there's something to be said for change.

The industry's newest technology represents the best we have to offer the American public. Lotteries often placed the fu-

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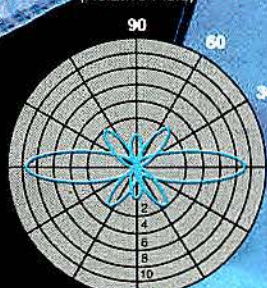
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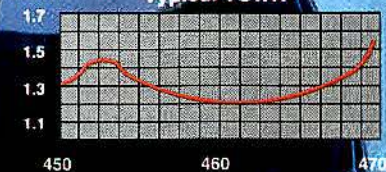
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Regulating technology

ture of these technologies in the hands of lucky licensees who didn't know a radio from a radish.

Held to the responsibility to construct systems which they did not understand, these doctors and brokers and plumbers would fall prey to the promises of companies that speculated in fresh grants. Meanwhile, the result of brilliant research and development was peddled at its lowest common denominator.

FCC and lotteries

The fact is, the FCC is sick of lotteries. The bright idea for holding lotteries was a byproduct of the FCC's processing of the first round of cellular applications.

Applicants prepared their applications with the expectation that the FCC would engage in comparative hearings to determine which applicant's system would best serve the public interest—in other words, which entity would make the most of the new cellular telephone technology and service so that the greatest number of people could enjoy the benefits.

The FCC put its engineers to the task of analyzing the applications. It assigned a separated trial staff of lawyers and clerks

to prepare designation orders. It selected the administrative law judges who would weigh the evidence and grant the licenses. The procedure was set and the competition began, but not without problems.

Non-wireline companies argued that telephone companies had an unfair advantage in the process. Small glitches in the rules were found.

*New technology, even
when duplicated between
applicants, spawns
unique approaches to
solving a particular
problem or delivering a
particular service.*

States wanted greater say in how the new cellular carriers would be regulated, and methods of interconnection, resale, MSA

coverage and a number of other areas of contention threatened to topple the whole procedure.

Meanwhile, the separated trial staff quietly told the engineers that their analyses were too good; that is, for some markets it was obvious that none of the applicants had proposed a decent system, or worse, that the differences were so technical, the trial staff thought the eventual decision would be debated at administrative trials and before the courts for years.

Solution by declaration

The FCC commissioners, sensing a collapse of the proceeding and predicting that the cost would be enormous for the FCC to conduct comparative hearings for the hundreds of metropolitan statistical area (MSA) and rural service area (RSA) markets, immediately declared that there just wasn't much difference between applications.

This claim was repeated often, although a review of the applications would have shown that there were considerable differences between the competing systems. New technology, even when duplicated between applicants, spawns unique ap-

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not only damages the reputation of Motorola, Inc. and the communications industry, but undermines the very integrity of America's public and private communications services.

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Regulating technology

proaches to solving a particular problem or delivering a particular service. But the FCC was searching for a way out of its comparative hearing dilemma, and lotteries were the chosen panacea.

Applications to go

Enter the cookie-cutter application.

By the third round of cellular applications for MSA markets 60-90, companies were being created to assemble and pack-

age applications for cellular licenses. By the time applications for the first RSA cellular licenses were accepted for lottery, mailboxes around the country were being filled with solicitations to join the competition for instant wealth.

The FCC had tried to get rid of the cost and hassle of comparative hearings. Now it was being treated to the unfettered excesses of the free market system.

It probably didn't help any that *lotto*

fever was sweeping the United States at the same time and that the FCC's lotteries boasted better chances to win than the 1 in 5.7 million chance usually whispered for the state-run contests. Later, if you were one of the people who filed applications for 220MHz-222MHz system licenses, the 1 in 100 chance of winning such a license probably didn't look too promising either.

About your preparer . . .

It also didn't help that the FCC chose to ignore its own rules and the law concerning the qualifications of persons who might prepare applications. Check the rules and the precedent in this area. Only applicants and their attorneys are supposed to prepare applications. Now people with little more knowledge about the FCC Rules than the people they served became overnight experts in lottery application preparation.

My favorite is the law firm that owns an application mill, but that clearly states on its lottery literature that when it's preparing your application, it's not serving as legal counsel. It begs the question, When is a lawyer not a lawyer? When he crosses his fingers, counts to ten and churns out another lottery ticket.

Just a few short weeks ago, Congress effectively scrapped the lottery as the way to bring new technology to market. Now auctions will be the method of choice.

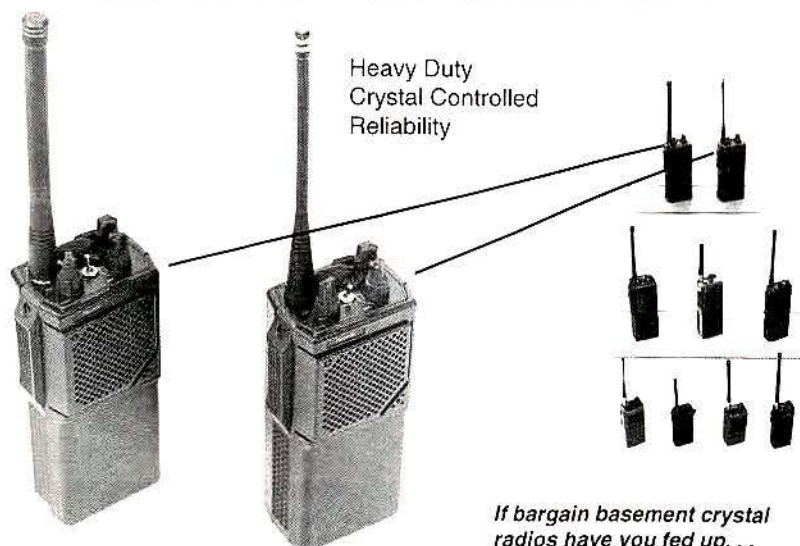
Auctions might improve the quality of the participants. Then again, they may just change the way the application mills do business. Instead of pretending that they are using investors' money to engage in experimental development of technology, these outfits may instead call themselves *investment pools*, seeking to raise enough money to put in a bid. But, at least they probably won't create competing pools that will bid against each other.

Public interest

Maybe I'm a bit old-fashioned. The dynamics of regulation sometimes appear to be a bit daunting as Congress and the FCC struggle to find their way back to the beginning, before there were television ads with 800 numbers to call to get an enhanced specialized mobile radio (ESMR) system started.

Whatever happened to deciding which applicant would serve the public interest best, with the newest technology, that would provide a necessary service to the greatest amount of people? I guess we tried that and it cost too much.

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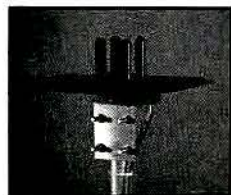
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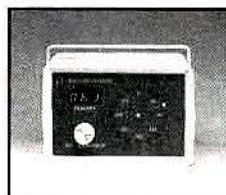
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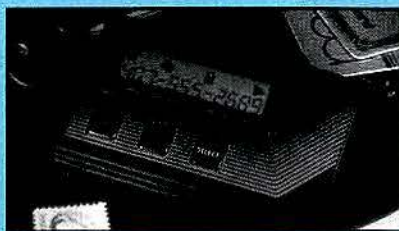
The BEST QUALITY is the BEST VALUE.

Readers' choice

Of all the new products and services in the April issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Credit card-size pager boasts 12-digit numeric display

The Confidant numeric pager from Motorola is only 1/4-inch thick, 2 inches wide and 3 1/4 inches long—the size of a standard credit card. The unit has a 12-digit numeric backlit readout for displaying phone numbers. It can retain as many as eight messages in memory, even when turned off or while the batteries are being changed. The Confidant also can act as a watch with its time features and will time stamp each message. Unless in the silent mode, a musical alert indicates



message reception. Reminder chirps sound if the message is not acknowledged.

Circle (500) on Fast Fact Card

Software aids in radio tuning

The Radio Spectrum Explorer for Windows by Advanced Computer Controls is a user interface for the VHF and UHF communications receiver. The program enables the user to explore the radio spectrum, tuning the radio in terms of what the user wants to hear, rather than frequency, making it easy to discover and monitor the wide range of signals present in the area.

Circle (501) on Fast Fact Card

Container protects radio equipment from water

Two-way radio communications applications where the user and equipment might get wet or even submerged can be protected by TEA's Davies OSK-1, a soft plastic, belt-mounted container that accommodates most radio brands and types with the antennas attached. A waterproof zipper provides access for the radio and allows the user to adjust channel, volume and other radio controls easily. A main cable junction box breaks out separate cables for the headset and PTT switch.

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Circle (54) on Fast Fact Card

Digital recording system provides instant playback

ProLog digital communications recording system provides user-specific security, instant playback, DigiMax sound quality and an optional touch-screen control. Features include precision search and playback control; time and date functions; search by channel name; next/previous message; incremental fast forward and rewind; and review. A graphical PC-based work station with a mouse and keyboard controls and configures the entire ProLog system from Dictaphone.

Circle (346) on Fast Fact Card

Radios offer eight user groups to communicate on own channel

The SynTronix series of VHF and UHF hand-held two-way radios from Advanced Videotech feature diode matrix frequency control, surface-mount component technology and the ability for eight user groups to communicate with each other on their own channel. Accessories include a flexible portable antenna, wall charger, rechargeable battery, wrist strap, protective case and belt clip. The radios are FCC-approved for use by public safety, business, industry and farming.

Circle (347) on Fast Fact Card

Mobilphones convert conventional radio into trunking radiotelephones

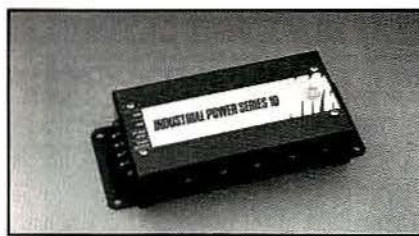
The RTX 8500 portable mobilphones consist of Maxon UHF or VHF SP-2000 hand-held radios modified by an RTX 7515 mobile control module that converts conventional 10-channel Maxon radios into 16-channel portable trunking radiotelephones. Features include multiple trunking groups for roaming on multiple systems; a private dispatch channel; the ability to place a telephone, dispatch or car-to-car calls from any specific channel with simple keypad entries; and complete RTX programming from the keypad without opening the cover.

Circle (348) on Fast Fact Card



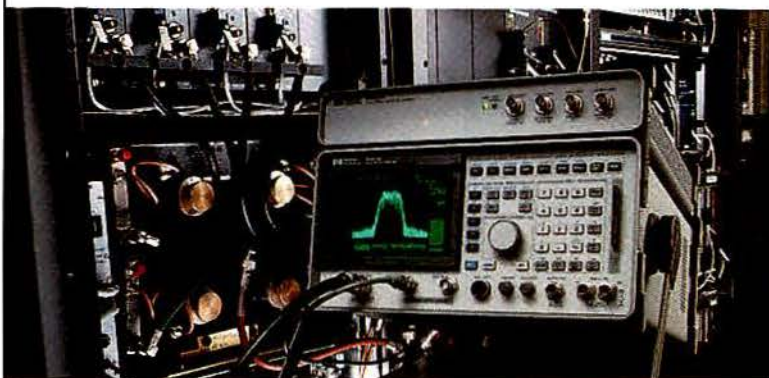
Converter is vibration-proof, moisture-resistant

The ICT2412-10AS converts 24Vdc to 12Vdc and uses four types of silicones and two types of Loctite to make the ICT converter vibration-proof and moisture-resistant. Other features include rugged anodized aluminum case, easy-access mounting holes, over-voltage protection, current limiting and terminal block for reliable wiring connection.



Circle (349) on Fast Fact Card

At last, a cell site tester that speaks Motorola, Ericsson, AT&T, GE, Northern Telecom, and Bob.



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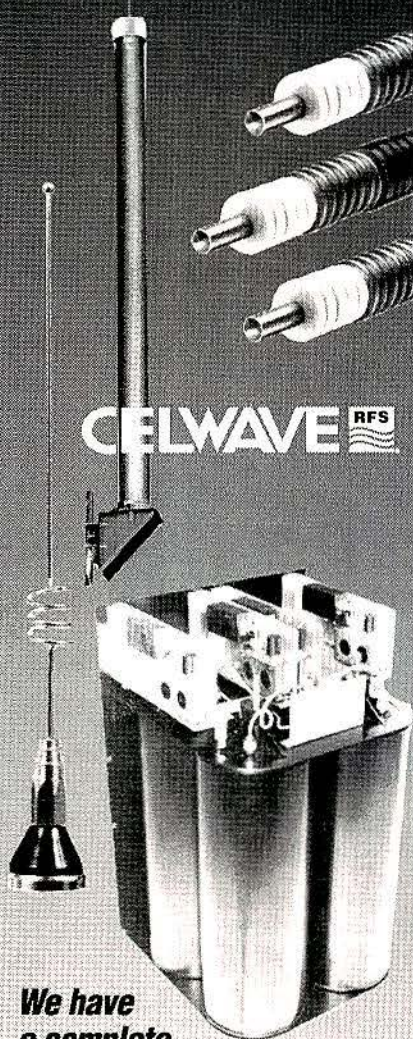
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Circle (55) on Fast Fact Card

New products

Software program monitors LTR system

The PCD-SAMT software program allows E. F. Johnson trunking system owners and technicians to monitor "on-air" home channel code activity and trunked codes. It runs on IBM PC-compatible computer systems. The software from **Pacific**

Circuit Design provides information on date and time of each code homed or trunked to the channel; duration of each transmission; total hits count for both codes and channel activity; total channel usage; and total channel dead time.

Circle (350) on Fast Fact Card

Paging protocol operates at 1,600 bps, 3,200 bps, 6,400 bps

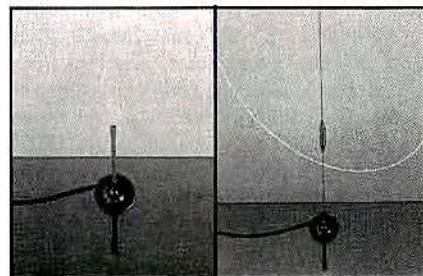
Flex high-speed paging protocol offers increased transmission speed, flexibility, improved data integrity and improved battery life. Flex operates at 1,600 bits per second (bps), 3,200 bps and 6,400 bps. It can be installed for easy mixing with existing POCSAG and Golay protocols. The system from **Motorola** is a fully synchro-

nous code that keeps portable paging receivers electronically in-step with the broadcasting station. It energizes the pager's electronics only when data is to be received in real time, significantly reducing pager power consumption and improving battery life.

Circle (351) on Fast Fact Card

On-window antennas feature adjustable ball-swivel joint

The Mini-Mark and Maxi-Mark on-window antennas from **Mobile Mark** are mounted on a circular base and attached with an adjustable ball-swivel joint. The Mini-Mark antenna features a small, flexible 3 3/4-inch whip, and the Maxi-Mark antenna features a 14-inch enclosed coil whip. The whips are interchangeable; the same base will accommodate either the Mini-Mark or Maxi-Mark. The Mini-Mark provides as much as 3dB gain and the Maxi-Mark provides as much as 5dB gain.

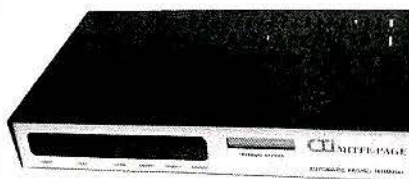


Mini-Mark

Maxi-Mark

Circle (352) on Fast Fact Card

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Circle (56) on Fast Fact Card

Mobile phone includes MIL-spec transceiver, backlit handset



Model 707-M DTMF mobile phones from Unibel automate the manual steps associated with DTMF trunking formats and provide "dial-and-press-send" automation for those using phone patches. The

707-M is available in UHF and VHF bands and is compatible with RTX. It includes a MIL-spec transceiver and a backlit cellular-style handset with a vacuum fluorescent display. Programmable options include connect and disconnect sequences, automatic dial tone detection, 10 independent operating areas, 99 channels, DTMF and CTCSS encode and decode, memory dial, last number redial and 10 independent ANIs.

Circle (353) on Fast Fact Card

Summit product line includes mobile, repeater

E. F. Johnson extends its Summit series of products with the Summit mobile and repeater. The Summit DM mobile features encryption, a unique Universal Digital and Data Interface, Write-On flash programming capability, programmable option buttons and a user menu function. The mobile offers Multi-Net features and meets all MIL STD 810 specifications.

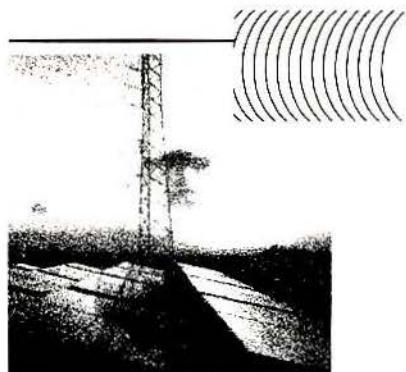
The Summit QX repeater fits an entire channel—logic, receiver, exciter, power amp and power supply—into a rack space 8³/₄" high. The repeater is modular for



optional feature installation and technology upgrades.

Circle (354) on Fast Fact Card

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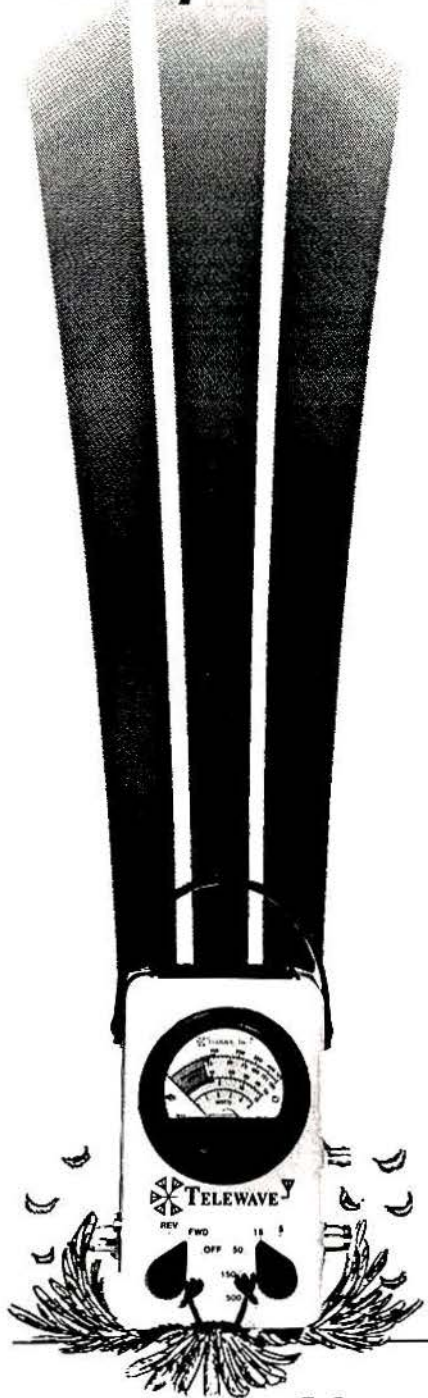
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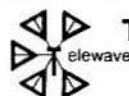
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Circle (58) on Fast Fact Card

New products

System automates, records frequency sweeps

Model SNA-900 with data interface automates and records the process of frequency sweeps to determine power-robbing faults or flaws in two-way radio and cellular antenna systems. The system from DCT simultaneously sweeps the system and immediately pinpoints the type

and location of the problem, which can include bad connectors, broken or damaged cables, lightning damage or water absorption. The unit is portable; weighs less than 7 pounds (minus the lap-top computer); and operates for more than 2 1/2 hours from its built-in rechargeable battery.

Circle (355) on Fast Fact Card

Chemical grounding rods available in two configurations

The chemical grounding system (CGS) from Jackson Telecom continuously conditions the soil to provide a low-resistance path from the earth to the unwanted electrical current. The rods provide the lowest resistance to ground regardless of the amount of moisture, type or chemical con-

tent of the soil. The system is available in two configurations. The horizontal system is made for installation in a trench, and the vertical system is made to be placed in a pre-drilled hole. The CGS can be placed under pavement or concrete slabs, or inside a building.

Circle (356) on Fast Fact Card

Duplexers available in seven models

The TMND series of mobile duplexers from Telewave use high "Q" helical resonators in a band reject configuration that creates exceptional frequency stability and 75dB isolation. Low insertion loss allows as much as 50W of continuous power.

Circle (357) on Fast Fact Card

Software package integrates two-way radio, computer, AVL

MDCOM-101 RF/Data communication network software package from Data-Air Technologies integrates two-way radio function with computer and vehicle location software. Features include forward error correction and detection, high-speed data transfer, data contention management and on-line diagnostics. Specialized modules are available to provide graphics, imaging and transfer capability for point-to-point and mobile data applications.

Circle (358) on Fast Fact Card

Pager features angled top-mount display

The Bravo Encore! pager from Motorola features a control forward design that puts the most used controls on the front of the pager and an angled top-mount display that makes reading messages easier. The pager has a memory capacity for as many as eight 12-digit numerical messages, time-of-day readout and message time stamping. The Bravo Encore! alerts the user to an incoming message in the silent vibration mode or by a melodic tone. It is powered by a single AAA battery.



Circle (359) on Fast Fact Card

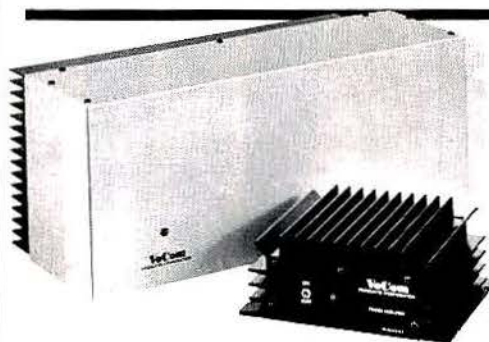
Software transforms real-time data into customer traffic patterns

Cellpost and Pagepost version 1.1 software packages for the Cellscope 2000 and Pagetracker 2000 wireless system monitors are available from TSR Technologies. By using any PC, Cellpost and Pagepost transform real-time data files into exact accounts of customer traffic patterns and statistics; improper or suspicious cellular or paging activity; and detailed MTSO and paging terminal activity. Specific observation intervals can be entered to limit the data analysis to specific dates and/or time periods.

Circle (360) on Fast Fact Card



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Circle (60) on Fast Fact Card

Data sheet discusses Mobilphones

A data sheet describes the operating features and advantages of RTX's 9800 series of trunking Mobilphones. The line consists of Maxon SM-4000 mobile radios equipped with RTX 7510 mobile control modules to convert them into trunking radiotelephones. The data sheet covers other performance features of the line, including 16-channel service, 40W of power and easy-to-operate controls.

Circle (400) on Fast Fact Card

Brochure discusses line of two-way radios

A free six-page color brochure describes the features and benefits of the fully-programmable Syn-Tech XTR two-way radios from Midland LMR. The brochure outlines several newly developed options and accessories for special applications including built-in data modems, vehicular repeaters and software-controlled trunking.

Circle (401) on Fast Fact Card

Catalog lists industrial electronic components

A 240-page catalog describing the latest industrial electronic components features a short index on the cover, as well as a comprehensive index of both manufacturer and product categories. The catalog from Mouser Electronics contains more than 42,000 in-stock, factory-authorized product selections from more than 90 manufacturers and features new product listings from several manufacturers.

Circle (402) on Fast Fact Card

Brochure includes tower product lines

A 24-page brochure provides an overview of Microflex, its engineering, fabrication and construction capabilities and product lines of self-supporting towers, custom towers, guyed towers, passive repeaters and waveguide support systems and components. The brochure includes information on the technical services department, which offers such services as transmission line maintenance, calibration and repair to turnkey installation of a communications system.

Circle (403) on Fast Fact Card

Catalog lists communications sites

"On Top of the World" is the name of AAT Communications' new telecommunications site catalog. It contains computer-assisted map drawings to help radio communications users and service providers select locations for their base station and repeater antennas.

Circle (404) on Fast Fact Card

Catalog features structural lightning protection equipment

A product catalog contains information on Lightning Master's line of structural lightning protection equipment, transient voltage surge suppression products, grounding materials and consulting services.

Circle (405) on Fast Fact Card

Brochures describe flexible communications cables, connectors

Two brochures and a price list feature the LMR and T-Com series of flexible communications cables and connectors. The brochures from Times Microwave Systems give detailed specifications and applications information for both series.

Circle (406) on Fast Fact Card

Catalog covers non-ionizing radiation safety products

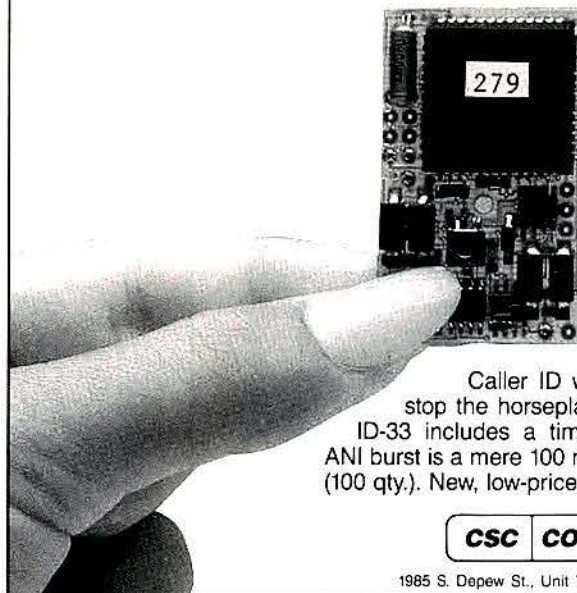
A 50-page catalog presents the line of non-ionizing radiation safety products from Loral Microwave-Narda. Complete specifications and technical data are included for personal monitors, area moni-

tors, survey instruments and a new family of induced current products. The catalog discusses who needs to monitor radiation and what types of equipment will help maintain a safe environment.

Circle (407) on Fast Fact Card



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Circle (61) on Fast Fact Card

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Circle (62) on Fast Fact Card

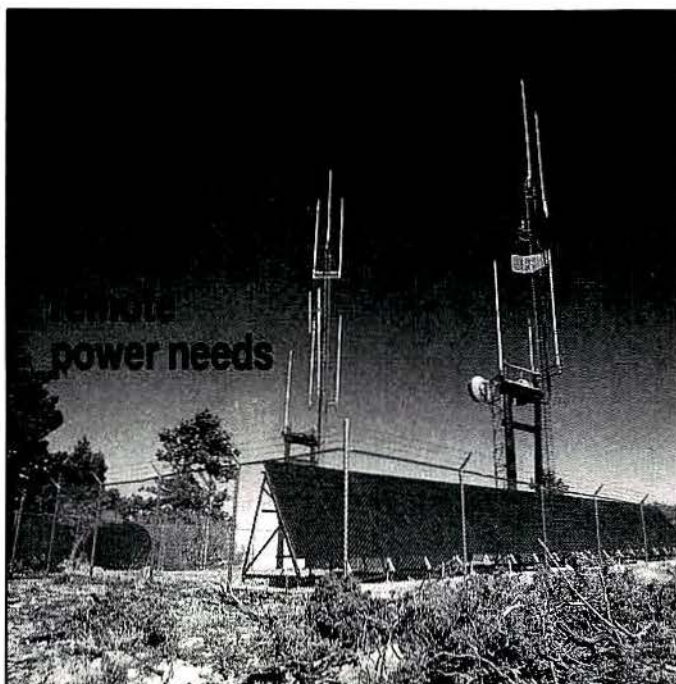
Protecting equipment when lightning strikes

According to 76% of the respondents to April's "What Do You Think?" questionnaire, a person can not prevent lightning from striking a tower; however, 92.7% believe that it is possible to protect equipment when lightning does strike. Readers noted that they use the following lightning prevention or protection devices (multiple answers add up to more than 100%):

Power line surge protectors	89.6%
Telephone line surge protection	83.3%
Grounding kits	81.3%
Coaxial cable surge protectors	80.2%
Metal ground rods	78.1%
Grounded bulkhead entrance panels	66.7%
Ground bus systems	60.4%
Lightning rods	53.1%
Radial ground systems	46.9%
Data line surge protectors	42.7%
Gas gaps	37.5%
Ion or static dissipaters	15.6%
Chemical ground rods	10.4%
Storm-tracking equipment	7.3%
Signal reference grids	7.3%
Other	13.5%

Three other readers wrote in that prayer sometimes helps.

The majority of the respondents, 57.8%, own their towers; 10% lease the space; and 32.2% combine owning and leasing.



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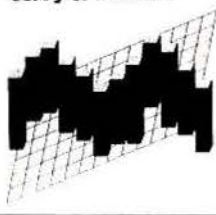
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P eople

Dick Krajewski departs Motorola, Schaumburg, IL, as key accounts manager to join Transcript International, Lincoln, NE, as direct sales manager of state and local government.

Promotions at Tower Structures, Chula Vista, CA:

Jon Mitchell, sales associate, advances to sales manager.

Don Weirauch, construction operations manager, moves up to vice president.

Thomas R. Losson departs Mnemonics, Melbourne, FL, as vice president of operations to become vice president of business development at Harris Electronic Systems division, Melbourne.

Douglas A. Jones exits Motorola Canada as vice president and director of distribution for Canada to join Sinclair Radio Laboratories, Aurora, Ontario, as president. **Robert W. Wier**, who had been serving as chairman and president, continues as chairman.

Raymond R. Dashner exits Fujitsu Ten, Torrance, CA, as sales and marketing vice president to join Connect Systems, Ventura, CA, as national marketing and sales manager.

James A. Pautler leaves McDonnell Douglas, St. Louis, as division deputy for total quality management to become vice president of engineering at Pinpoint Communications, Dallas.



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Circle (65) on Fast Fact Card

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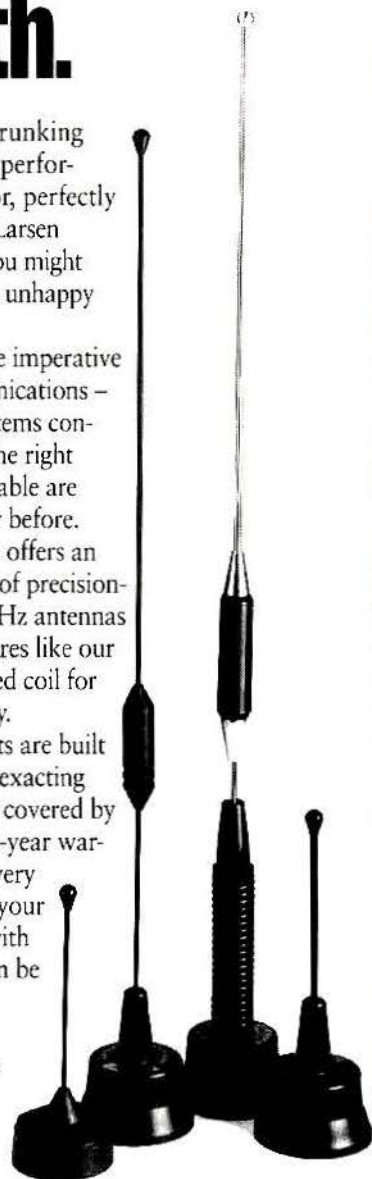
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Circle (66) on Fast Fact Card

Last technician:

On reading the May letter to the editor from Rod Wheeler of Diamond Bar, CA, regarding the past, present and future of the two-way radio shop, I was left with little hope for the future.

Upon reflection, though, I have come to believe that two-way radio still can offer a better future than giving it all up and starting a llama ranch.

During the last couple of decades, two-way radios certainly have changed, and it is getting pretty tough to make a living out of working with simple voice communications two-way radios. Two factors appear at this time to be defining the future of our field.

One is that two-way radios are increasingly just one component of a mobile system for moving information by wireless means. The other is that control of the wireless domain or RF spectrum, as the conduit for information flow, now is very much up for grabs.

To prosper in the future, two-way radio persons will have to continue to expand their knowledge and involvement in the devices and systems that attach to two-way radios. Computer, fax, video and whatever else the future brings will need radio and electronic technical expertise and support to make them effective in the wireless environment.

The difference from yesterday may be that, when a customer drives up to a two-way radio shop for help, the problem will not be that the two-way radio does not work. Something may be wrong with the video-fax-data-voice radio system.

A key issue today is how restricted current two-way radio system operators will be in their future ability to access the wireless medium. Two short decades ago, quite a battle was fought over the interconnection of innovative radio technology with the public switched telephone network. That recent history should remind us of how the act of limiting access can limit innovation.

It would be ironic if the telephone companies that so recently were forced to open their wired networks to wireless and other technology innovators ended up being able to block future innovators in the wireless medium. The same would apply to any large single-interest business group gaining control to both large chunks of the RF spectrum and the complete end-to-end suite of technology using that spectrum.

Two-way radio people have a strong history in leading the new perceptions of information and defining the technology that moves it from place to place. If the FCC ensures that RF spectrum access is kept open for these innovators who most often are happy and productive working in small businesses, the future still can be bright.

What we see today is an evolution of the wireless field.

The two-player approach of those who use the technology and the airwaves and those who provide the equipment and systems is changing to a three-party approach of those who are technology users, those who are system and network financiers and developers, and those who work with technology users and system providers to create innovative technology solutions for the users and a greater information flow through the systems. The growth of the network provider is necessary and important to broadening access to the RF spectrum by many potential users.

On the other hand, the RF spectrum belongs to the public and cannot be sold off permanently in a manner that does not serve the long-term public interest.

If the spectrum refarming results in large blocks of the business and industrial radio spectrum being controlled by financial interests that close access to RF spectrum in a way that resembles how access to the wired communications network was closed prior to AT&T's divestiture of its operating companies, then the whole "RF field" will have to be plowed up and planted again, most likely at a huge future expense to taxpayers.

If refarming is done right, including making sure that two-way radio small business innovators are able to maintain their active, innovative role, we can end up with a long-term formula for everyone's success.

Rand G. Ellis
Marketing Manager
Radio Systems
Fort Lauderdale, FL

Fast Fact Card comments:

The toughest problems on the job are:

- keeping up with new development.
- lack of people with background.
- shortage of new technicians.

Robert M. Davis
State Microwave Specialist
Bureau of Land Management
Phoenix

The two toughest problems facing me on the job are:

- radios too small to see and fix.
- minimum requirement for parts orders.

J.W. Hopson
Technician
East Alabama Communications
Alexander City, AL

Mobile Radio Technology

The journal of mobile communications technology

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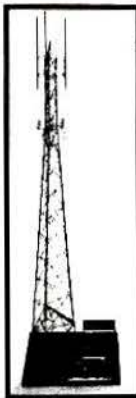
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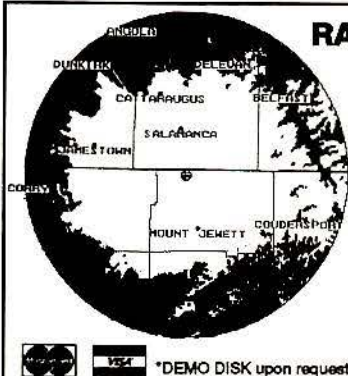
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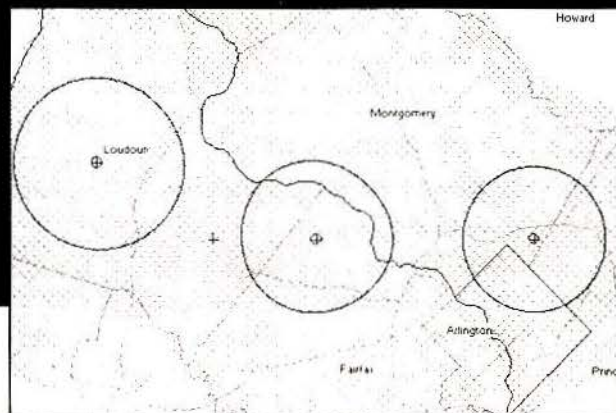
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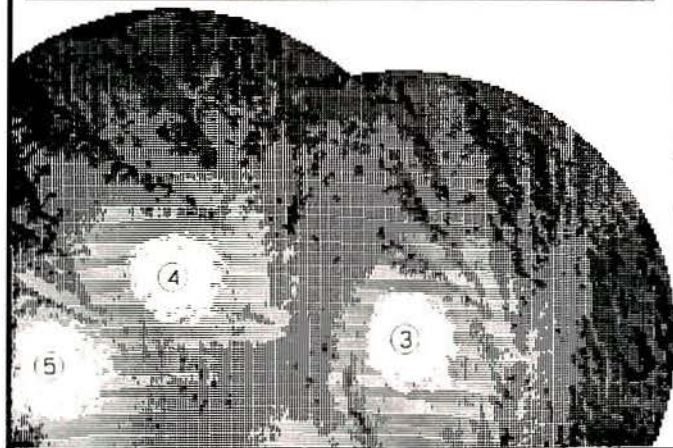


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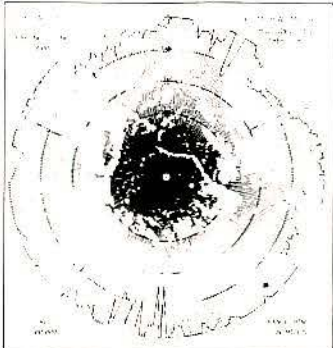
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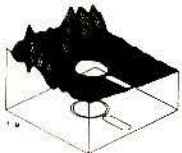
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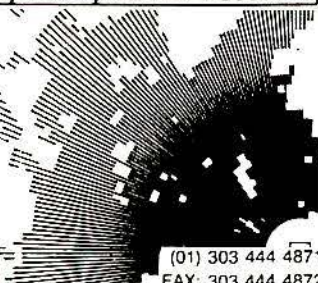
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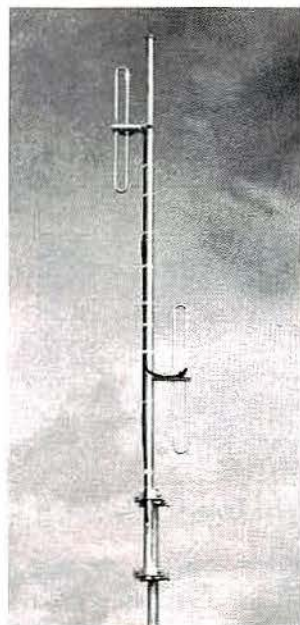
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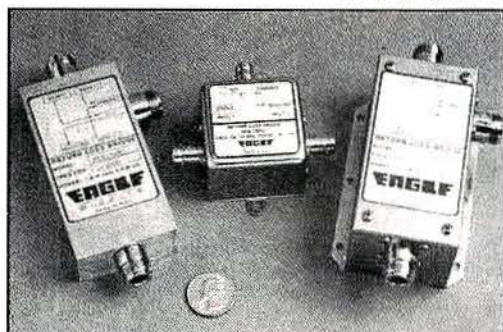
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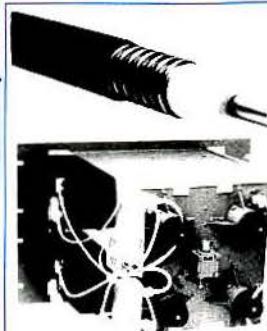
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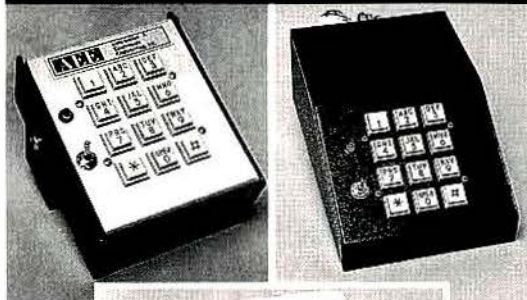
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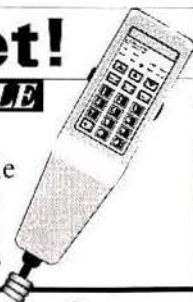
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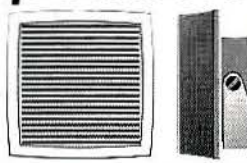
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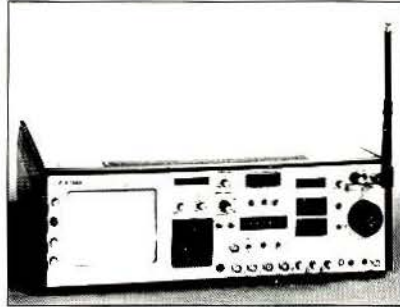
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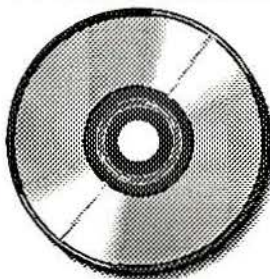
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Automation & Electronics Engr.	85	104	800-527-4596	Motorola C & E	59,76	49,111	708-576-5484
Avtec Inc.	46	35	803-892-2181	Motorola Government	17	13	800-235-9590
A W Enterprises	61	52	800-334-4884	Multiplier Industries Corp.	14	10	800-642-2424
BatteryPRO Centres Inc.	58	47	800-661-9401	MX-Com, Inc.	7	7	919-744-5050
BEE Electronics Inc.	62	53	708-345-0337	Norcomm Corp.	30	20	916-477-8400
Cartwright Communications	48 A-B		800-543-8614	Norton Engineering	75	78	703-938-5745
CELWAVE	22-23	15	800-321-4700	Paging Wholesalers	62	54	818-240-5640
Centurion International, Inc.	9	8	800-228-4563	Palomar Telecomm, Inc.	83	100	619-746-7998
C.E.T., Inc.	73	75	904-426-0014	Pekaar Communication, Inc.	78	84	201-772-0704
Chargeguard Corp.	84	113	800-458-3410	Percon Corporation	87	82	716-386-6015
Cimarron Technologies	25	16	800-487-7184	Photocomm, Inc.	68	63	800-223-9580
David Clark Co., Inc.	49	38	508-751-5800	Polaris Industries	86	105	800-752-3571
Communication Instruments	87	110	800-288-8223	Primus Electronics Corp.	84	107	800-435-1636
Communications Associates	19,85	14,102	800-435-9313	Pyramid Communications	83	99	414-730-4190
Communications Data Services	74	79	800-441-0034	Quantum Publishing, Inc.	58	48	800-422-9666
Communications Specialists	BC	3	800-854-0547	Radio Central, Inc.	80	90	205-476-9484
Control Signal Corp.	67	61	303-989-8000	Radio Express, Inc.	81	92	703-266-1928
CPI Communications, Inc.	42	31	214-437-5320	Radio Wholesale	79	88	800-53-RADIO
CTI, Inc.	64	56	601-287-8081	Ramsey Electronics	82	96	716-924-4560
Cushcraft/Signals Corp.	27	18	800-258-3860	RCW Distributing	79	86	800-726-9015
Cushman/KNS Electronics	87	109	408-432-8100	Ritron, Inc.	55	44	800-USA-1USA
Decibel Products, Inc.	39	28	214-631-0310	Rocky Mountain Comms, Inc.	73	77	303-526-5454
D & L Communications Inc.	69	65	219-484-0466	Sante Fe Distributing	64	55	913-492-8288
Doppler Systems, Inc.	60	51	602-488-9755	Schlumberger Technologies	53	42	800-225-5765
Eagle Wichita	84	115	316-942-5100	Selectone Corporation	3	5	800-227-0376
EDX Engineering Inc.	74	80	503-345-0019	Sentry USA	73	76	407-773-6090
Ericsson GE Mobile Comms	41	30	800-GE1-2345	Sharp Communication	79	87	800-548-2484
Ericsson North America	15	11	800-835-3742	Shinwa Communications of America	32	22	800-627-4722
E Trunk Systems, Inc.	82	95	914-245-1128	Softwright	75	81	303-344-5486
Fanon Courier	85	101	800-345-1354	Solar Electric Specialties	65	57	707-459-9496
Gamber Johnson	44	33	715-344-3482	Sonic Communications, Inc.	68	64	800-688-1944
Henry Radio	52	40	800-877-7979	Tait Electronics USA, Inc.	36	24	713-984-8684
Hewlett Packard	32 A-B,33,63	23,67	509-921-4001	Telewave, Inc.	65	58	415-968-4400
Hustler, Inc.	57	46	800-949-9490	Telex Communications, Inc.	16	12	800-554-0716
Hutton Communications	26	17	800-442-3811	Transcrypt International Ltd.	5		800-228-0226
Hy-Q International	79	89	606-283-5000	Unibel Developments, Inc.	86	106	800-367-2500
ICOM America	47	36	206-454-8155	Uniden Corp. of Am-MSG, Inc.	29	19	817-858-3300
IFR Systems, Inc.	43	32	316-522-4981	Unipage	50-51	39	800-367-2864
Intertec Information Age Books	68		913-967-1856	VCP International Inc.	66,67	60,62	800-527-9366
Larsen Electronics	69	66	800-426-1656	Vega, A Mark IV Company	1	4	818-442-0782
Lazer Beepers, Inc.	77	94	305-595-9165	Versatel Communications	84	108	800-456-5548
Lett Electronics Co.	81	93	913-234-6721	Vertex/Yaesu USA	IBC		310-404-2700
Link Communications, Inc.	83	97	717-848-1656	Vocom/RF Corporation	66	59	800-USA-MADE
Maxrad, Inc.	13	9	800-323-9122	WAVETEK	31	21	800-245-6356
McManus Communications	78	83	501-763-6250	Zetron, Inc.	40,56	29,45	206-820-6363
Mechem Electronics	83	99	703-373-3888				

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Frequencies

FTL-1011 Lowband:
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FTL-2011 VHF:
134-174 MHz, 40 Watt
FTL-7011 UHF:
400-512 MHz, 25 Watt



FT-80C HF SSB Transceiver
20 Channels, 1.8-30 MHz

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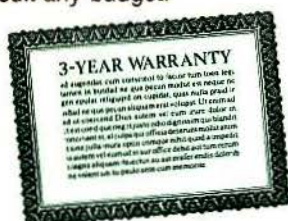
VHF/UHF Repeaters
VXR-5000 – RF Synthesized 136-174 MHz, 400-512 MHz, 25 Watt (shown.)
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Specifications subject to change without notice.





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